

F-104 **STARFIGHTER** *in action*



squadron/signal publications
AIRCRAFT NO. 27

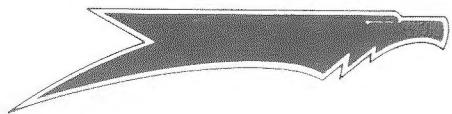
Low Dendel
1976

F-104

STARFIGHTER

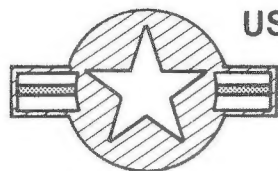
in action

by Lou Drendel

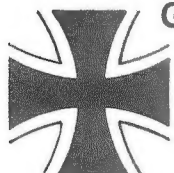


squadron/signal publications

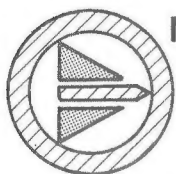
National Insignia of 15 Air Forces to Operate the F-104



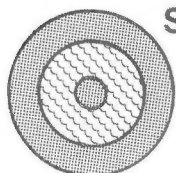
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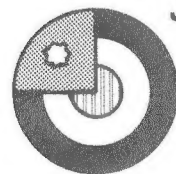
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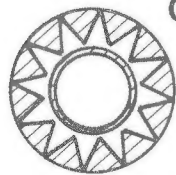
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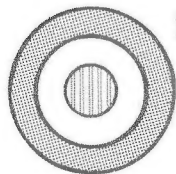
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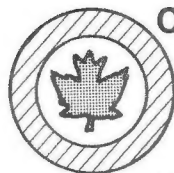
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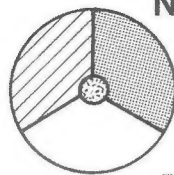
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(Nationalist)



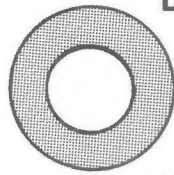
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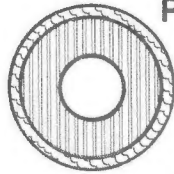
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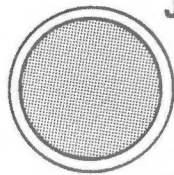
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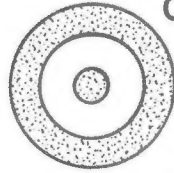
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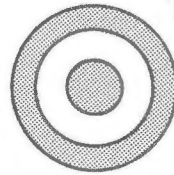
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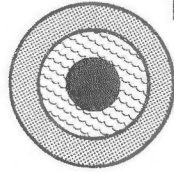
JAPAN



GREECE



TURKEY



BELGIUM

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Red



White



Blue



Black



Lt. Blue



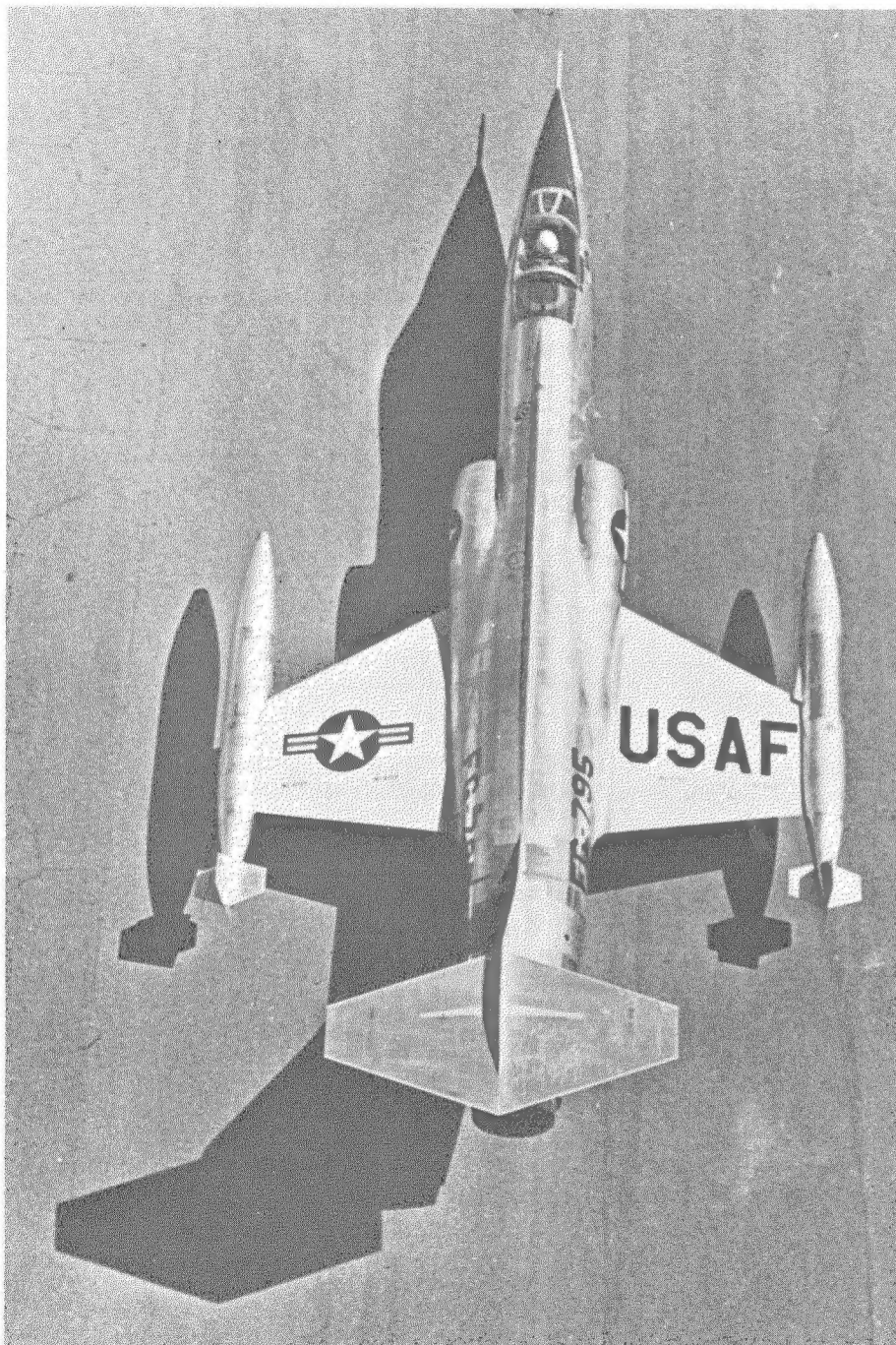
Green



Orange



Yellow



Introduction

"It is the most dangerous, insidious airplane that I have ever flown, having many coffin corners that you can get yourself into without natural warnings...and leaving yourself no place to go!"

Believe it or not, those are the words of a veteran Starfighter Pilot, who is a big fan of the F-104. The manned missile from Lockheed's famed "Skunk Works" has engendered this love/hate relationship in thousands of the free world's fighter pilots. It is an airplane that, when flown to the optimum of its performance envelope, could outshine any of its contemporaries, but when mishandled would be unforgiving in the extreme.

The genesis of the Starfighter is a legacy of air combat lessons learned during the Korean War. Fighter Pilots emerging from battle with the Mig-15 (their 10 to 1 kill ratio not withstanding) wanted a machine which could outperform the nimble Russian fighters. They were winning their air war with old head saavy...making the Migs fight on their terms. If they had to go to war again, they didn't want to take the chance that the communists would not learn from Korea. They wanted an air superiority fighter and the Air Force, with a clarity of foresight borne of a shooting war, agreed. And so it was that in March of 1952 the Lockheed design team, under C.L. "Kelly" Johnson, began work on what was to become the most widely used double sonic fighter ever developed. By November the F-104 had emerged as the needle-nosed, short-winged, high-tailed purebred that it has remained for nearly a quarter of a century.

Two prototypes of the Lockheed model 83 were ordered, under the designation XF-104, in March of 1953. The two prototypes were to be powered by the Wright J-65 engine, and would be used to flight test the new lightweight fighter concept. (The lightweights of the 70's are somewhat tardy follow-ons to the original modern lightweight fighter...the F-104) The first of the prototypes to take the air was 53-37786, making the Starfighter first flight on 7 February, 1954. Max performance of the J-65 engine was realized on March 25, 1955, when the XF reached a speed of Mach 1.79.

The concept had been proven, and the fifteen YF-104A's which followed the two XF's embodied several design changes, not the least of which was the more powerful General Electric J-79 engine, which would prove capable of pushing the 104 beyond Mach 2. (And its structural design limits.)

The YF-104A, with its General Electric YJ79-GE-3 engine, hit mach 2 in a flight on April 27, 1955. The following February, the first F-104A made its maiden flight, but because of the new and broadened technological horizons being bridged by the Starfighter, it would not see service with operational units for nearly two years. The F-104 flight test program was one of the most exhaustive ever undertaken for a fighter, involving fifty two airplanes and more than eight thousand flights before operational certification.

The F-104A finally reached operational status in January of 1958, with the 83rd Fighter Interceptor Wing of ADC. Its debut was shortlived. A series of engine problems resulted in several accidents which led to the grounding of all F-104's in April. Eventually the 104's were retrofitted with the J79-GE-3B engine, and returned to service, but the bloom was off the rose. It



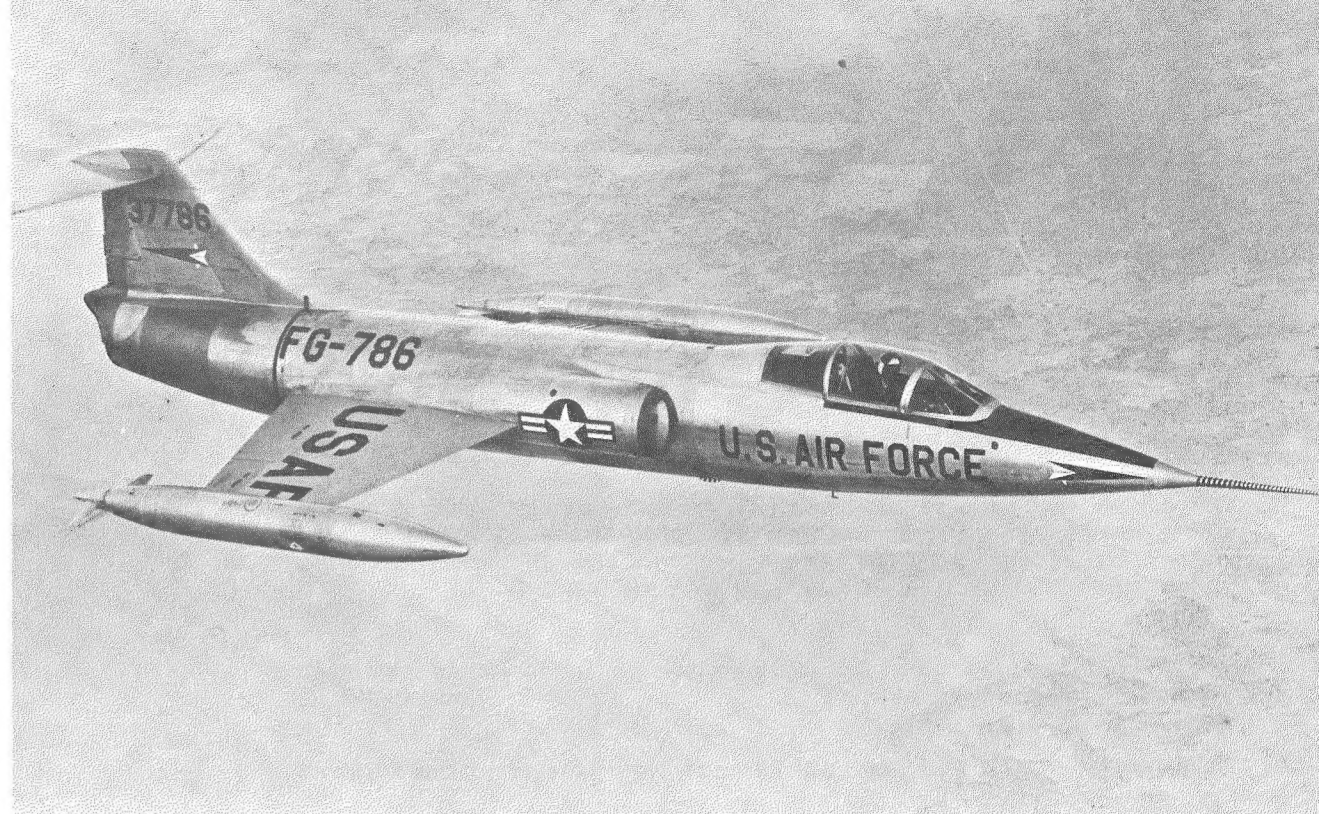
First five of the "Century Series" of American fighters pose for a group portrait. Note that all five are early models of the respective marques. [USAF via Col. Don Kutyna]

was apparent that the Starfighter lacked the "seven league boots" to provide adequate air defense coverage...at least with the numbers of 104's then planned for production. And it's avionics were strictly VFR oriented, putting it outside of the then existant system for all-weather intercept missions. Before the decade was out the Starfighter had been removed from the USAF active combat inventory. Twenty five of the F-104A's were given to Chiang's Nationalist Chinese, and twelve went to King Hussein's Jordanian Air Force. Twenty four suffered the ignominy of conversion to QF-104A drones almost before their first set of tires were worn out! Three were converted to NF-104A's, and may have drawn the top glamour assignment of all Starfighters. The remainder wound up with the Air Guard.

While the F-104A was still in the flight test phase, a two seat version was flown for the first time, in February, 1957. It was designated the F-104B, and the addition of the second tandem cockpit dictated the removal of the Vulcan cannon, some avionics and fuel. It's flight characteristics were essentially the same as the A model, and it served as both trainer and operational backup to the F-104A.

Despite the problems encountered with the F-104 in it's initial operational deployments, it's impact on aviation technology cannot be denied. It broke every record in sight, and left the competition gasping for breath as they staggered back to their drawing boards. The same year that the Starfighter entered service with operational units, had it's problems, was grounded, and eventually reinstated, it also set records for straightaway speed, altitude and time-to-climb to seven different levels. During May of 1958 the F-104A reached an altitude of 91,243 feet, and hit an average speed of 1404 mph on the two way course. A year later, in response to the record altitude flight flown by the Navy's Phantom, USAF raised the redline on the Starfighter from Mach 2 to Mach 2.4 for a one-time altitude record attempt. They were not disappointed. The 104 went over the top at 103,395 feet!

Lockheed was confident about it's manned missile's future, and was not satisfied with the limited prospects of sales to USAF's ADC. During 1958 it introduced the F-104C, which featured a more powerful engine, provision for aerial refueling via the removable boom on the left side of the fuselage, and the capability to carry and accurately deliver air to ground stores. 77 of the "C" model were built, and TAC's 479th TFW was the only USAF operational unit to fly it in the late 50's.



The first XF-104 during an early test flight from Edwards AFB. Note unusual position of buzz number and national insignia. [Lockheed]

XF-104 in flight. The early configuration intake geometry is readily apparent, as is the shorter fuselage length. Max speed attained by the XF-104 was 1.79 mach. [Lockheed]

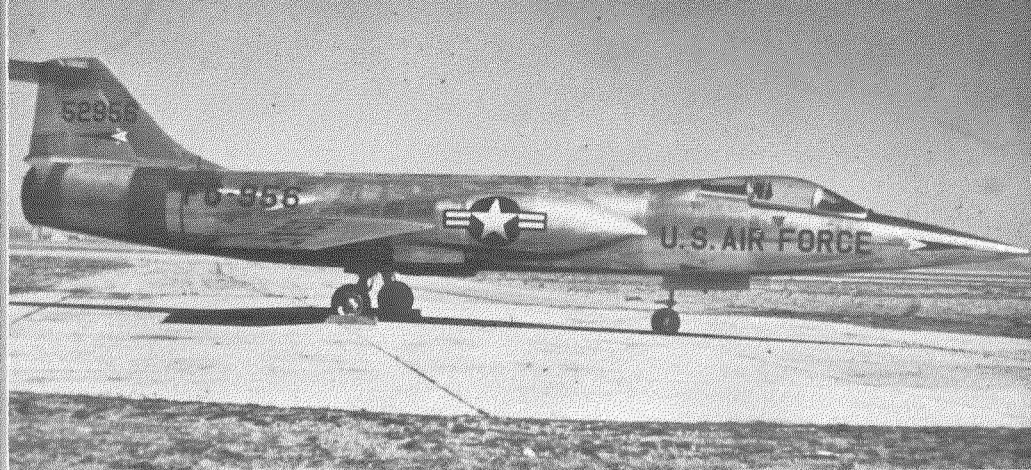
Lockheed's enthusiasm for the Starfighter may not have found a welcome reception in the United States, but Europe's Air Forces were still rebuilding and they looked upon the 104 as their chance to prove their worth as military allies, while picking up some residual prestige from the operation of the world's hottest fighter plane. In March of 1959 the West German government became the first of several NATO countries to sign license production agreements with Lockheed. The Starfighter would eventually be built by no less than seven countries, including the United States, Germany, Canada, Netherlands, Belgium, Italy, and Japan. It would be operated by 15 Air Forces, making it the most widely used double sonic fighter in history. (Besides the countries producing the F-104, it was operated by the Air Forces of Nationalist China, Jordan, Pakistan, Spain, Denmark, Turkey, Greece, and Norway.)

The Starfighter production program cannot be overstated. It was one of the most significant defense happenings of its day, from the Lockheed sales effort on to the successful realization of complete commonality of all parts from all factories. It helped to strengthen the free world alliance through the shared production responsibility and the operation of identical support facilities at Air Force Bases all over Europe. It set the pattern for several such

joint ventures in the years to come. (Though none would be as successful or widely accepted until the advent of the lightweight fighter of the 70's.) The manufacturing countries not only gained manufacturing expertise, they gained immeasurable logistic planning capabilities, technological knowledge, and economic side benefits. The Starfighter's career has been one of superlatives...worldwide superlatives.

F-104 Production Distribution

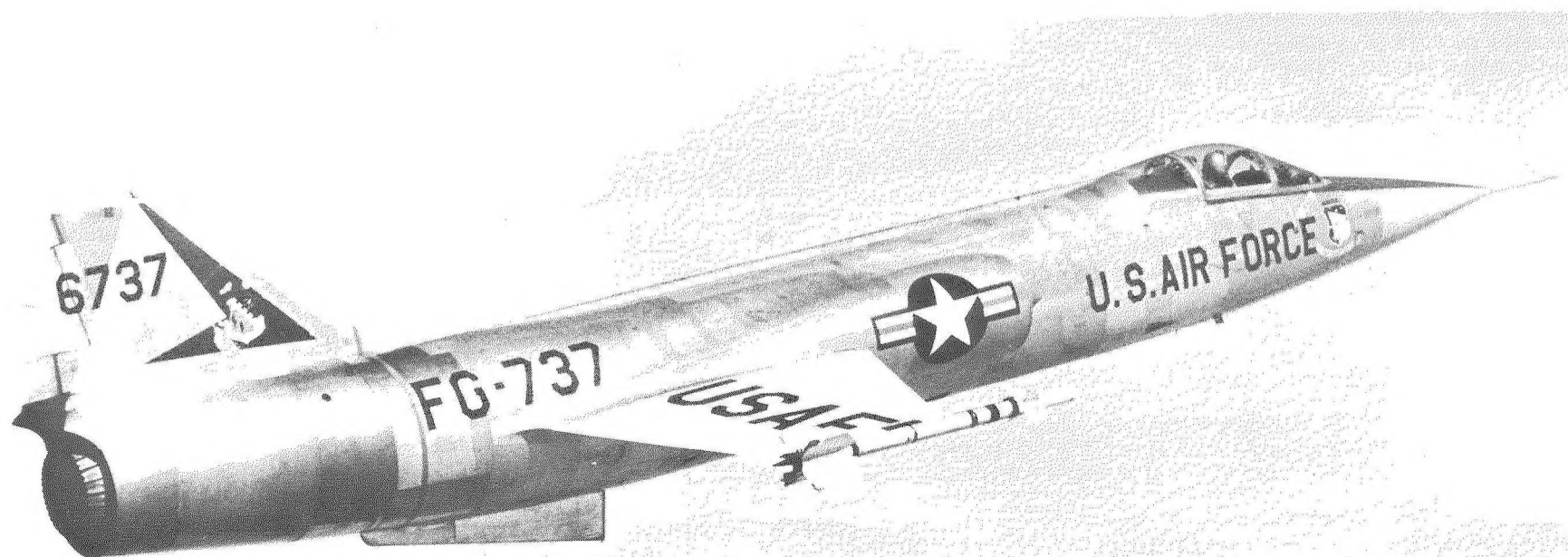
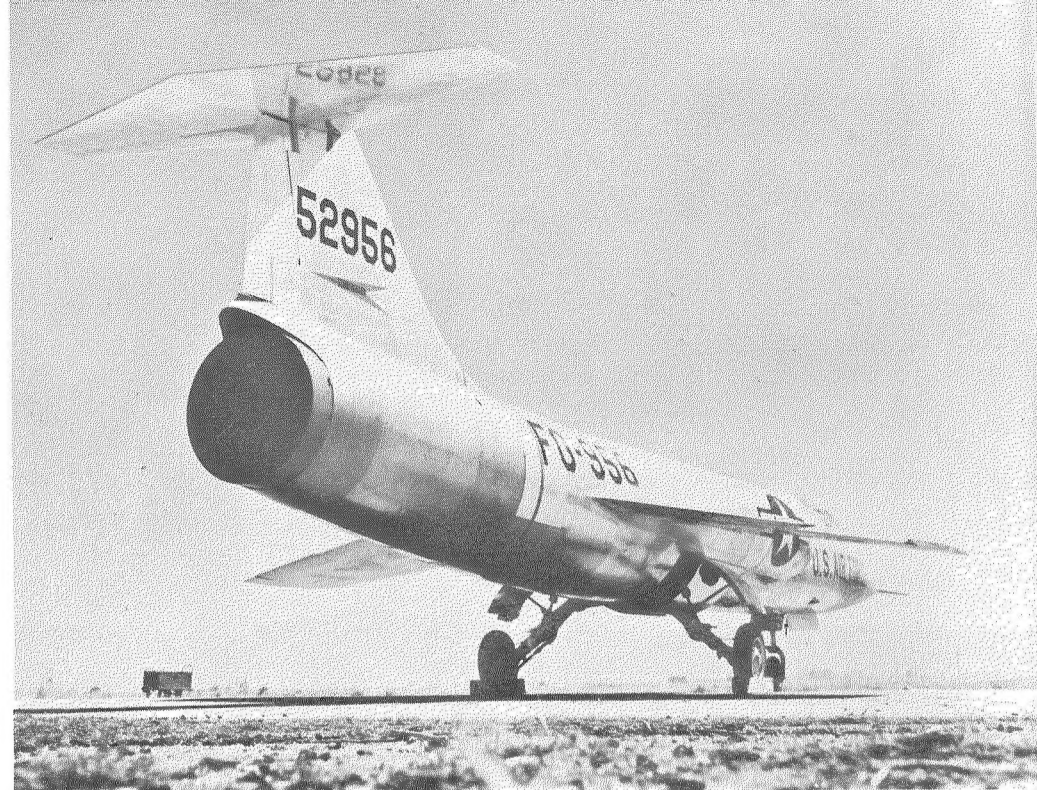
No. of F-104s	Delivered To	DELIVERED BY:						
		Lockheed	Canada	Germany	Netherlands	Belgium	Italy	Japan
297	USAF	297						
250	USAF/MAP	110	140					
238	CANADA	38	200					
230	JAPAN	23						207
917	GERMANY	240		283	255	89	50	
138	NETHERLANDS	14			99		25	
112	BELGIUM	3				109		
354	ITALY	12					342	
2,536		737	340	283	354	198	417	207



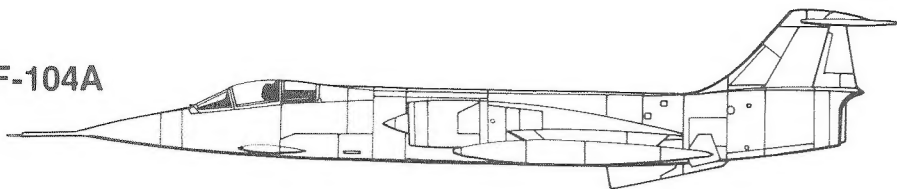
Second YF-104A. The YF-104A was the first of the breed to incorporate the more powerful GE YJ-79 engine, and redesigned intakes. The intake cones were secret enough to warrant concealment with special covers when being photographed, as shown in this view. [USAF via Menard]

YF-104A did not have ventral fin, added on later models for lateral stability at high mach numbers. [Lockheed]

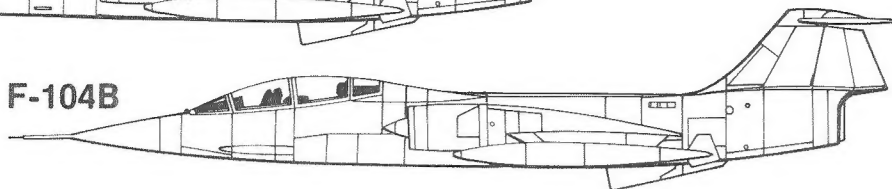
F-104A of USAF Test Pilot School at Edwards. Note exhaust nozzles in closed position. [USAF]



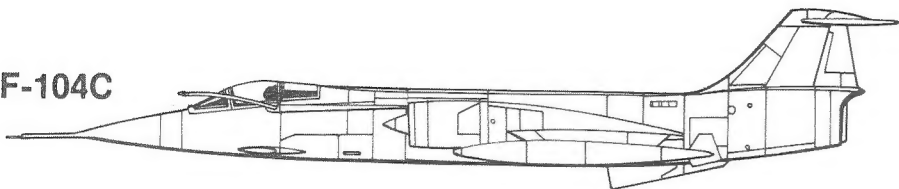
F-104A



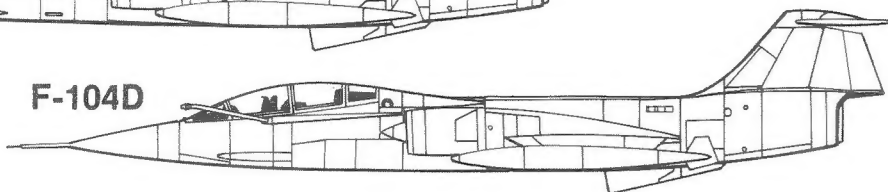
F-104B



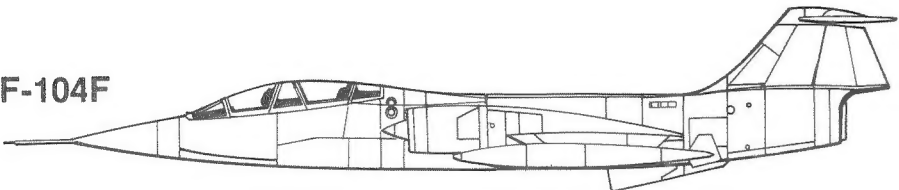
F-104C



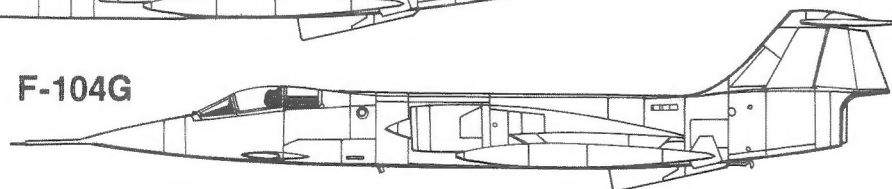
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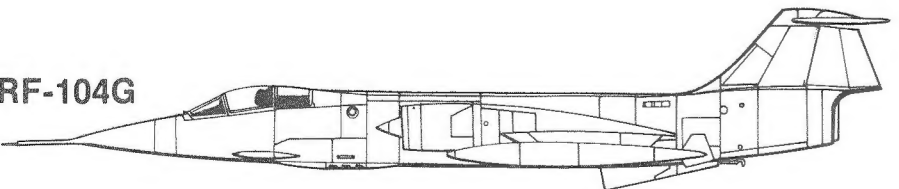
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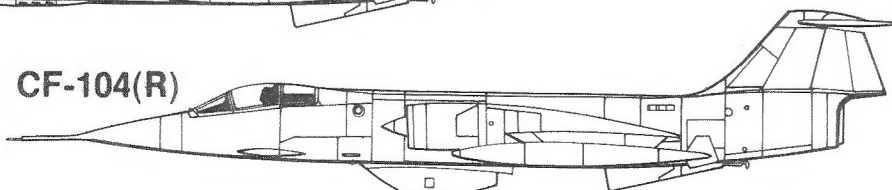
F-104G



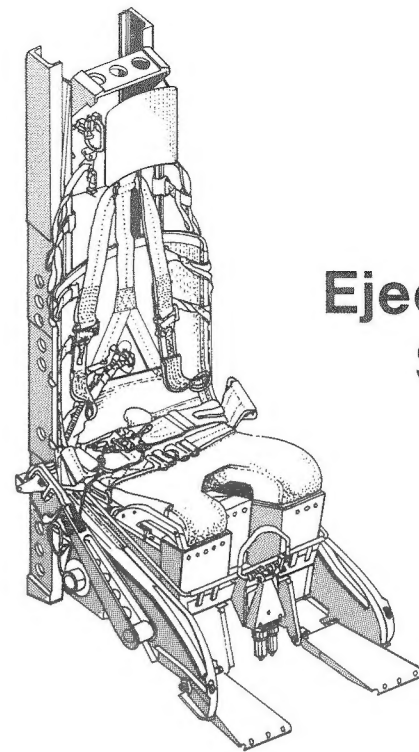
RF-104G



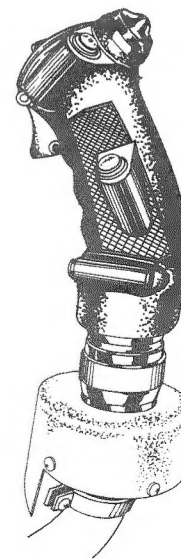
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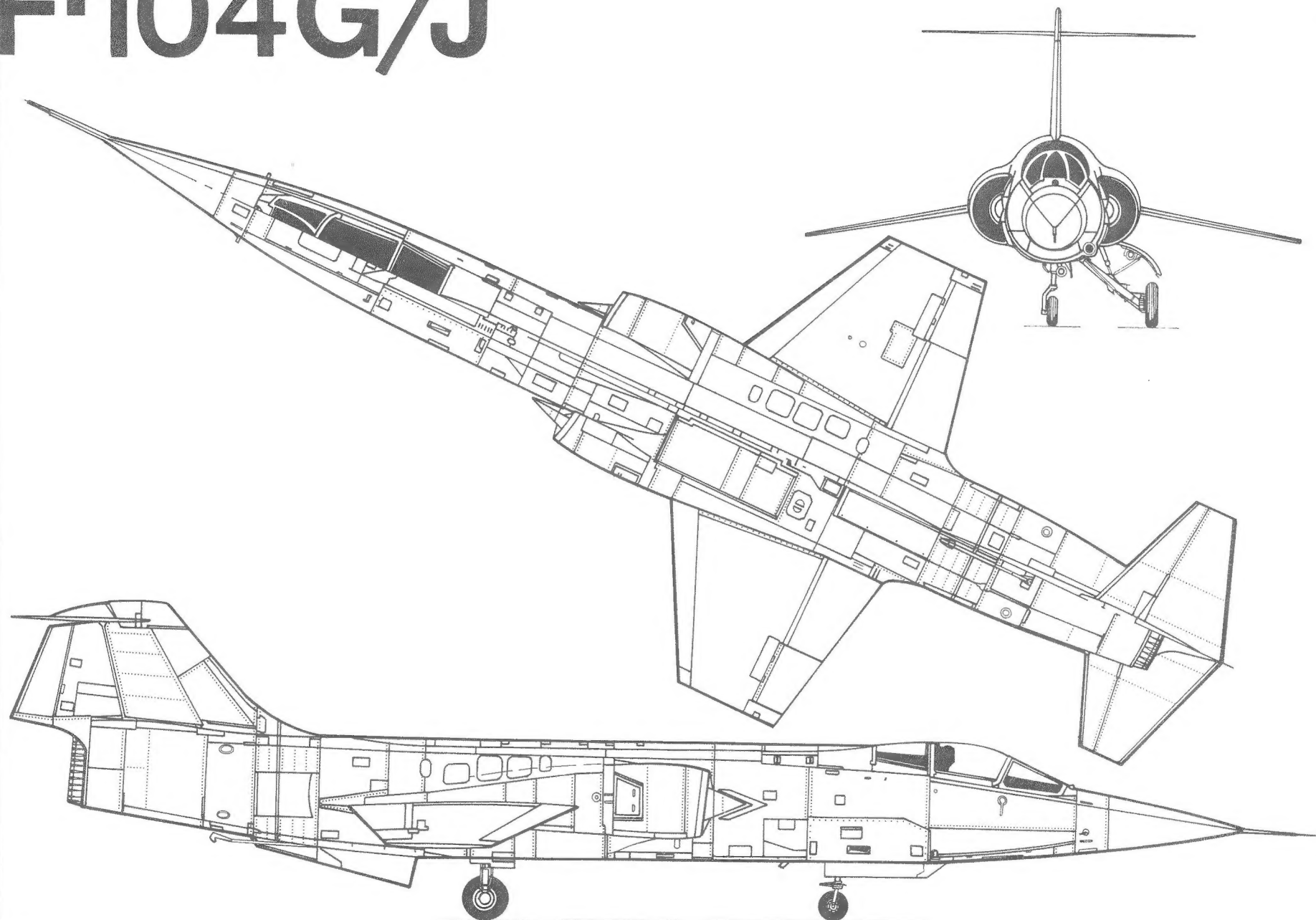
**Ejection
Seat**

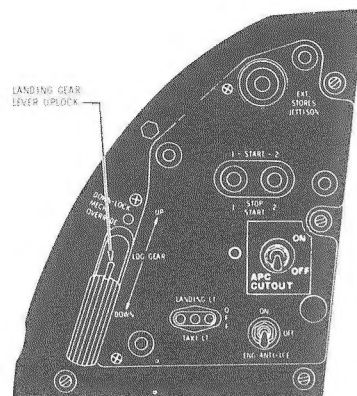


**Control
Stick
Grip**

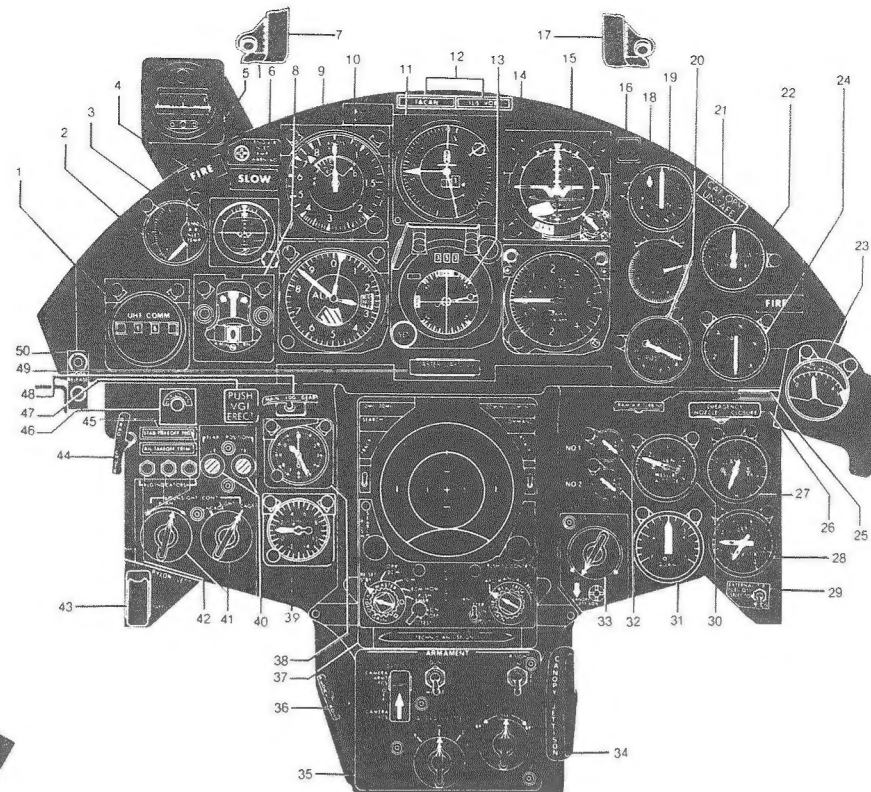


F-104G/J

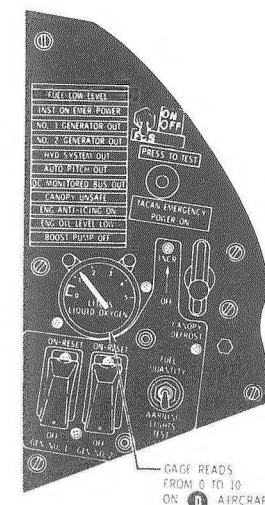




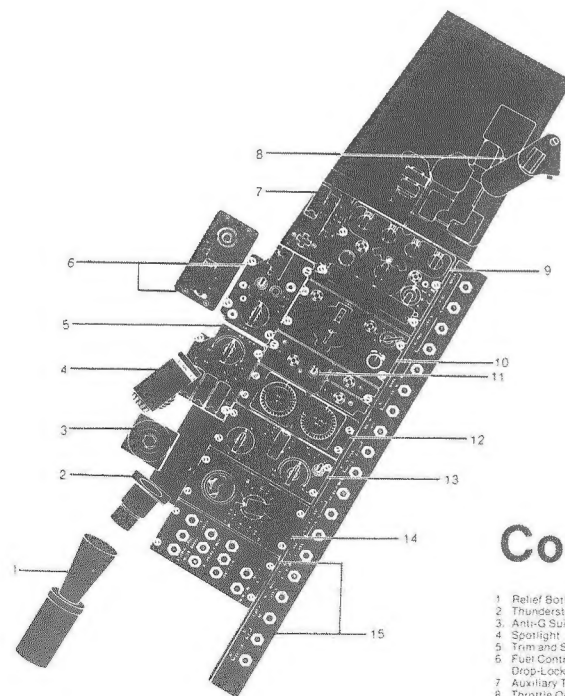
Left Forward Panel



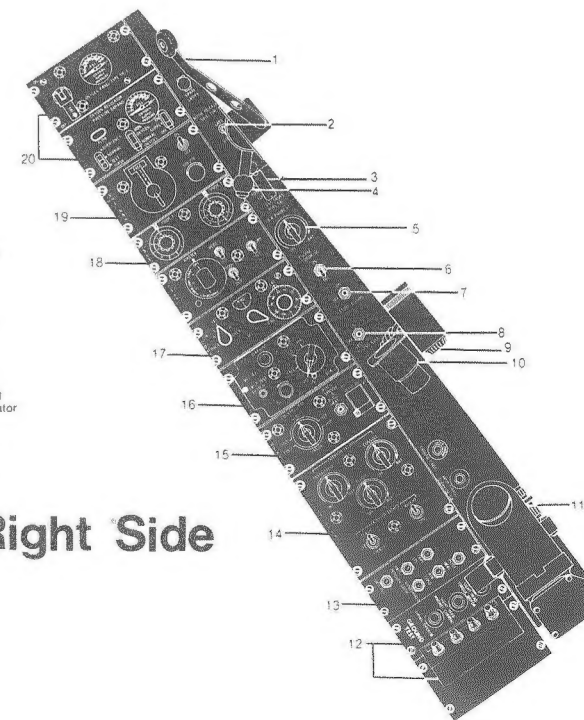
Instrument Panel



Right Forward Panel



Cockpit Left Side



Cockpit Right Side

1. Remote Channel Indicator
2. CIT Gage
3. Standby Attitude Indicator
4. Fire Warning Light (2)
5. Standby Compass
6. CIT Warning Light
7. Radar Lock-On Indicator Light
8. Turn-and-Slip Indicator
9. Airspeed and Mach Number Indicator
10. Altimeter
11. Bearing Distance Heading Indicator (ID-526 BDHI)
12. TACAN-ILS/VOR Indicator Lights
13. Course Indicator (ID-249)
14. Altitude Indicator
15. Vehicle Velocity Indicator
16. Main Fuel Shut-Off Valve
17. Load Indicator Light C
18. Tachometer
19. Exhaust Gas Temperature Gage
20. Exhaust Nozzle Position Indicator
21. Canopy Unsafe (Flashing) Warning Light
22. Fuel Flow Indicator
23. Automatic Pitch Control Indicator
24. Oil Pressure Gage
25. Ram Air Turbine Extension Handle
26. Emergency Nozzle Closure Handle
27. Internal Fuel Quantity Indicator
28. External Fuel Quantity Indicator
29. External Fuel Quantity Selector Switch
30. Cabin Altimeter
31. Nucleonic Oil Quantity Indicator
32. Hydraulic System Pressure Gages
33. Face Plate Heat Rheostat
34. Canopy Jettison Handle
35. Armament Control Panel C
36. Rudder Pedal Adjustment Handle
37. Radar Scope and Control Panel
38. Clock
39. Accelerometer
40. Wing Flap Position Indicators
41. Gunsight Control Switches
42. Landing Gear Position Indicator Lights
43. Pylon Jettison Switch
44. Drag Chute Handle
45. Stabilizer and Aileron Take-Off Trim Indicator Lights
46. Radar Lock-On Sensitivity Control
47. Push-to-Erect Vertical Gyro Indicator
48. Manual Landing Gear Release Handle
49. Master Caution Light and Reset Bar
50. Arresting Hook Release Button and Arresting Hook Down Warning Light

Specifications — Lockheed F-104 Starfighter Series

MODEL	XF-104	F-104A	F-104B	F-104C	F-104D	F-104F	F-104G
Span (ft.)	21.5	21.94	21.94	21.94	21.94	21.94	21.94
Length (ft.)	49.17	54.77	54.77	54.77	54.77	54.77	54.77
Height (ft.)	12.7	13.49	13.49	13.49	13.49	13.49	13.49
WT. Empty (lbs.)	11,500	12,562	12,866	12,526	13,073	13,066	13,592
T.O.G.W. (clean) (lbs.)	15,700	18,881	17,831	19,566	18,700	18,663	20,625
Take-off Speed (knots)	187	175	167	177	174	173	182
T.O.G.W. (max.) (lbs.)	15,700	24,585	23,535	27,537	24,388	24,377	28,580
Landing Speed (knots)	139	145	149	143	148	146	153
Max. Speed (Mach)	1.64	2.0	2.0	2.2	2.0	2.0	2.2
Range (max.) (n.m.)	800	1444	1091	1642	1,388	1,388	1,628
(Combat Configuration)	no TT or PT	keep TT drop PT	keep TT drop PT	keep TT drop PT	keep TT drop PT	keep TT drop PT	drop TT & PT
Altitude (max.) (ft.)	50,500	57,750	56,250	59,000	57,500	57,500	60,000
Fire Control System	TYPE K-19 Mod. AN/APG-34 Radar	AN/ASG-14T1	AN/ASG-14T1	AN/ASG-14	AN/ASG-14	—	F-15A NASARR
Navigation System	Gyro Compass	AN/ARN-56 TACAN J4	AN/ARN-56 TACAN J4	AN/ARN-55 AN/ARN-56 J4	AN/ARN-55 AN/ARN-56 J4	AN/ARN-56 MM-3 J4	LN-3 Inertial TACAN PHI
M-61 Gun	yes	yes	no	yes	no	no	yes
Ordnance (max.) (lbs.)	—	310	310	—	310	310	4,310
Engine	J65-B-3	J79-GE-3A	J79-GE-3A	J79-GE-7	J79-GE-7	J79-GE7	J79-GE-11A
No. External Store Stations	2	5	4	5	5	5	5

TT = Tip Tanks

PT = Pylon Tanks



F-104G shows off open speed brakes and drag chute door. [directly to the rear of the ventral fin]
 F-104G [G was for Germany, the first foreign country to order the Starfighter] was the most produced of Starfighter variants, and is entering it's 17th year of service as this is written. [Lockheed]



AIM-9 Sidewinder

[Left Above and Below] Rear cockpit panel and right console of F-104B.



Lockheed technicians make adjustments to Starfighter engine and avionics [Above] during test program. Wing leading edge covers are visible in photo above left. The covers are necessary to protect ground personnel from the sharp [1/16" radius] leading edges during ground maintenance. [Lockheed]



Lockheed mechanic installs protective screen over intake prior to ground runup of engine. [Screens prevent induction of foreign objects, including mechanics.] [Lockheed]



Strength of the 7½ foot wings is evidenced by demonstration of...the Carioca?
[Lockheed]



F-104A's of the 157th FIS, South Carolina Air National Guard, demonstrate the Starfighter's excellent formation handling qualities. Air Guard units got the F-104 early in it's career, and operated it longer than most active duty units. [SCANG via Norman E. Taylor]

[Right, Above and Below] Lockheed operated this TF-104G as a company demonstrator to aid in sales demonstrations to foreign countries, and to develop tactics best suited to taking advantage of the 104's best qualities. [See color painting on rear cover for marking details.] [Lockheed]

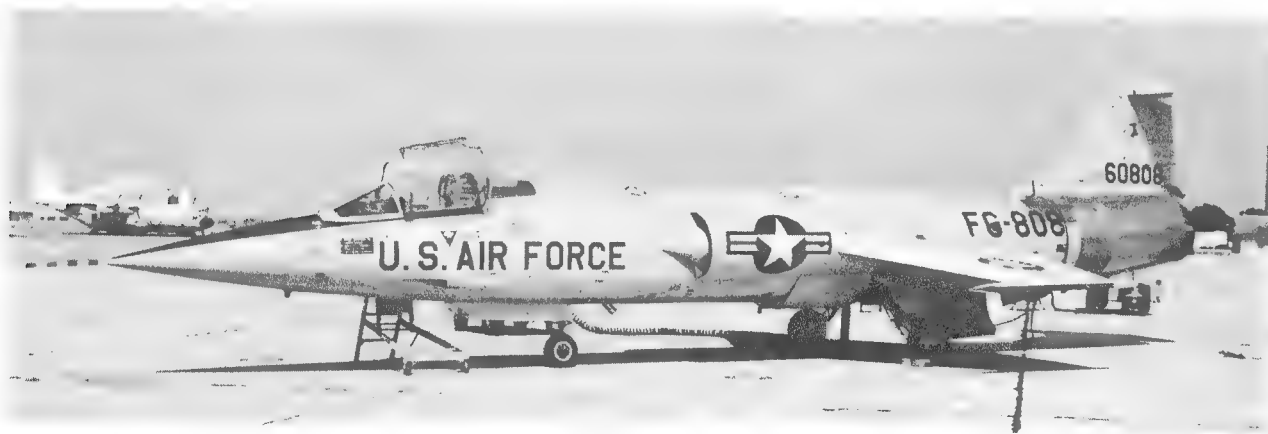


F-104A of the South Carolina Air Guard's 157th FIS. Note yaw damper under rudder in it's fully deflected position. [SCANG via Norman E. Taylor]





F-104A of the 83rd FIS. [Note Squadron emblem on vertical fin] "Vociferous Viking" was photographed in September, 1959, at San Francisco, by Douglas D. Olson. [via Paul Stevens]



[Above and Right] F-104A of the 319th FIS, Patrick AFB, Florida, May 1961. Squadron motto "We get ours at night" appears under tail emblem. Overall

grey paint scheme, with white wings. [Ken Buchanan]

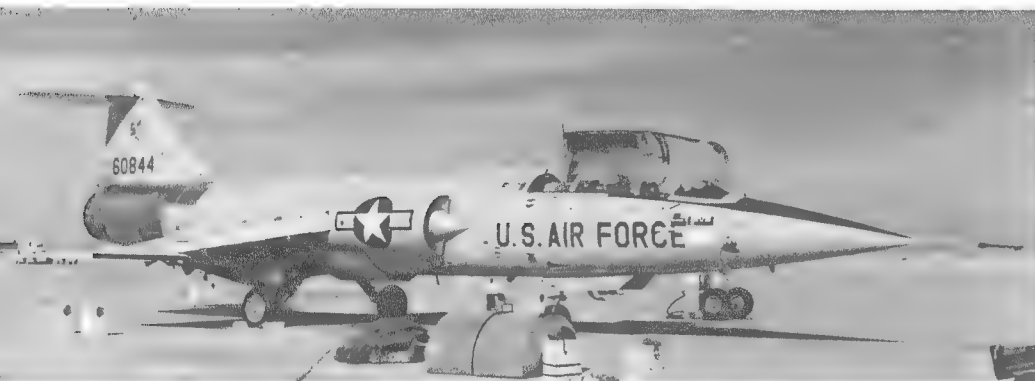


Tennessee Air Guard F-104A [151st FIS] at O'Hare Field in May, 1961. Immaculate finish is testimonial to the care that Starfighters received early in their career. [Paul Stevens] Squadron emblem was carried on tails of some ANG Starfighters. [Right] [Paul Stevens]





F-104A-15-LO, serial number 56-783a as it appeared in March of 1958, at Hamilton AFB, California. Note gun port cover, which was only installed when gun was not mounted. Also worthy of note are the myriad protective covers, and safety pins which must be removed before flight. [Douglas D. Olson via Paul Stevens]



F-104A-25-LO of the 331st FIS, ADC, as it appeared at Webb AFB, Texas in 1965. This particular Starfighter returned to active duty with Air Defense Command after service with the South Carolina Air Guard, during which service it was stationed in Spain for the Berlin Crisis of 1961. [Norman E. Taylor]



F-104A-20-LO at Andrews AFB in 1964. [Paul Stevens]



F-104D-5-LO at L.G. Hanscom Field, Maine in October, 1965. Tail and radome are light grey, white wings, balance of fuselage natural metal. [Thomas S. Cuddy II via Paul Stevens]



Canopy difference of F-104B [Top] and F-104D [Below] are evident in these views. Also note partially open ram air turbine door on photo above. [Brian Baker via Paul Stevens and R.M. Hill]



F-104D of the 436th TFS, based at George AFB, California was photographed at Elmendorf AFB, Alaska in November, 1963 by Norman E. Taylor. [Above] TF-104G at Luke AFB (Below) was used in USAF run West German pilot training syllabus. [Peter Bergainini via Stevens]





F-104A-20-LO of ADC's 331st FIS at Webb AFB, Texas. Squadron Emblem on nose, outstanding unit citation under "City of Kemp" inscription. [Norman Taylor]



F-104C-5 of the 479th TFW as it appeared at Eglin AFB for President Kennedy's inspection. TAC's air to ground philosophy is evident in types and variety of ordnance displayed for 104 use. Range and ceiling figures quoted on poster reflect optimum figures, which would not be achieved in combat. [USAF via Norman E. Taylor]



Formation of TAC F-104C's, with centerline stations installed. [Lockheed]



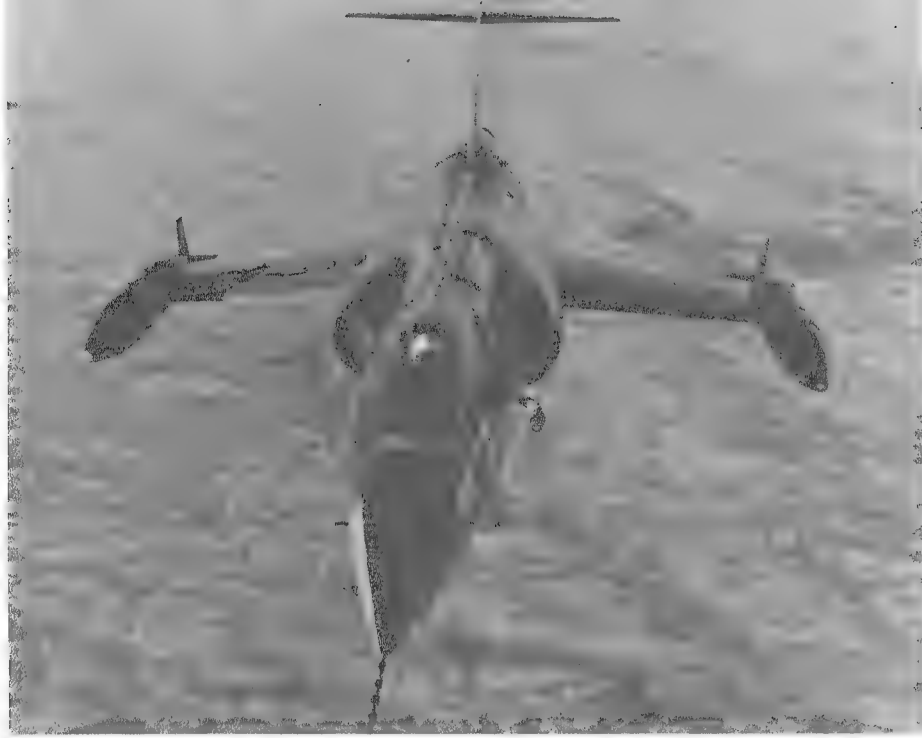
In November, 1963, the 436th TFS deployed twelve of it's Starfighters from George AFB, California to Elmenforb AFB, Alaska for a two week training mission. Temperature when this picture was snapped was -5 degrees. [N.E. Taylor]



One of the more colorfully marked F-104's was this "C" model, flown by WWII ace Col. George Laven, Jr., CO of the 479th TFW, George AFB, Calif. in the early 60's. This aircraft is the subject of Hasegawa 1/32 nd scale model of the F-104C. It later saw service in the Vietnam War, and was eventually to serve with the Puerto Rico ANG. [David Menard]

F-104C's of the 479th TFW in alternative markings. See color side view painting for details. [Lockheed]





Starfighters in Vietnam

Starfighter approaching KC-135 tanker. [USAF]

F-104C "Fannie", of the 479th TFW as it appeared during Vietnam deployment in 1965. [David Menard]

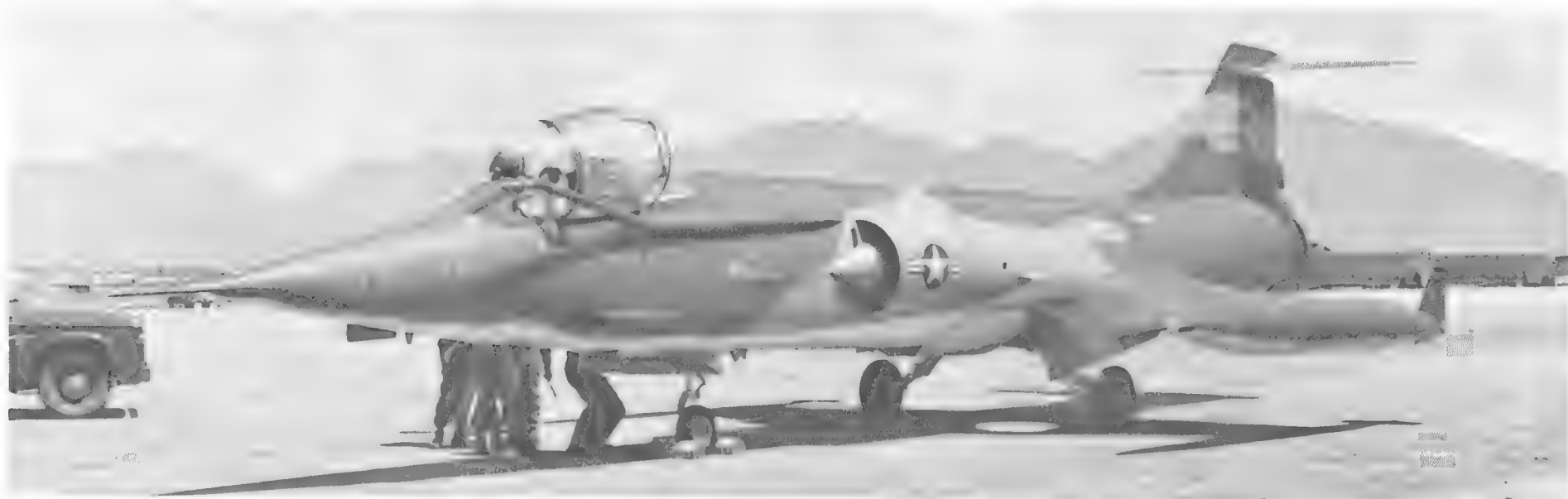




F-104C's at Udorn RTAB, Thailand in 1968. [USAF]



[Top and Above] F-104C's in Vietnam. Starfighter in lower photo bears the name "Time Hoe". [Neal Schneider via R.M. Hill]



F-104C in standard USAF camouflage adopted in 1966, and bearing the apropos sobriquet [for a Starfighter] "Smoke II". Though 104's were deployed to SE Asia for the sole purpose of MIGCAP, they never had the opportunity to

engage enemy fighters and eventually were used in the air-to-ground role...a role they were ill-suited to perform. They were not used on a sustained basis after 1967. [Neal Schneider via R.M. Hill]



Flying the Starfighter

Jim Milner recalled the first time he saw the F-104. "It was sitting in the alert hanger, and it looked as if it was going Mach two just sitting there!" He went on to tell me that it was his first love and, like all first loves, remains as the most memorable of his flying associations. He first checked out in the F-104 in 1960, and would subsequently check out twice more between assignments in other aircraft. In all, he amassed over 950 hours in the Starfighter and came to know its strengths and weaknesses intimately. This is his account of what it was like to fly the "manned missile."

The airplane was easy to fly, but very difficult to fly to the edge of the envelope, or to the maximum of its capability. I would say that it's the most dangerous, most insidious airplane that I've ever flown. If you don't know your way around the airplane, it has many coffin corners that you can get yourself into, and not be able to get out of. I have known many extremely competent pilots who have not been able to get out of coffin corners that the 104 has put them in.

It is a simple airplane to start, with a couple of exceptions. There are four "T" handles that got some people into trouble when they mixed them up. On opposite sides of the center console you have the canopy jettison and rudder pedal adjust handles. Since you almost always have to adjust the rudder pedals to your personal preference every time you fly the airplane, there is always the chance that you'll grab the wrong T handle. It has been known to happen, and believe me, there is nothing more embarrassing than to be left in

the chocks without a canopy! Above those T handles are the T handles for the emergency landing gear lowering system, and the ram air turbine extension. I have known lots of pilots who developed some very interesting mnemonics just to remind themselves of where these handles were.

The airplane handles well on the ground. When you select take-off flaps, the rudder limiter cuts out and gives you the full benefit of the nose wheel steering.

On engine runup before takeoff, with the early model engines you could go to minimum afterburner with no problem. But with the later, dash 19 engine, you couldn't even go to 90% without sliding the tires! The runup itself didn't take long. You'd do a throttle burst and a chop, check the inlet guide vanes to make sure that they were going right, and when everything looked right, you'd start your takeoff roll.

The acceleration of the 104 on takeoff is really impressive, and will leave you always behind the airplane until you get used to it. We had abort speeds that we precomputed, but the 104 with a healthy engine got there so fast that you really had a very fleeting "dead man's zone". (Too slow to eject, but too fast to keep it on the runway if you had to abort.) There were some engine problems at first, and takeoff was where you usually paid the supreme price for an engine problem. Iven Kincheloe was killed on takeoff when he had a cold shift on the engine inlet guide vanes, which in turn caused the engine to compressor stall. He was very low and the then standard downward ejection seat didn't give him room to get out of it. I flew the downward ejection seat airplanes on my first checkout, and we all breathed a sign of relief when the 104 was retrofitted with the upward seat in 1960.

One of the real dangerous things about the wing tanks on the 104 was the uneven load distribution that was possible if they were filled incorrectly. There were two cap tanks, with a forward and rear compartment. If you filled the rear and not the front, you would set up a "flutter", or oscillation that once started, would actually diverge, eventually tearing the wing off. One pilot took off in a "B" model with a cameraman in the back seat, to do some photo-chase work. At about 400 knots the tank began to flutter, the wing came off, and the airplane went into some very high roll rate gyrations. They both jumped out, but that was not the end of the story. This happened at Edwards AFB, and as luck would have it, it happened on one of our real windy days. (High winds are about the only non-flying weather that you get at Edwards.) The pilot was dragged across the lakebed by his parachute for about 25 to 30 minutes, wearing out the toes and heels of his boots, his flying suit, and choice portions of his anatomy. The cameraman came down behind him and seeing what was happening to his pilot, he decided to get out of his harness, then drop free when he got within a few feet of the ground. Unfortunately, he misjudged his altitude and dropped from high enough to break a leg. As a result of this, flying at Edwards was limited to days when the wind was under 25 knots.

Climb in the 104 was pretty straightforward for a high-performance airplane. Once airborne and cleaned up, you would accelerate to .92 mach, then hold that speed until you reached about 35,000 to 40,000 feet, at which point you pushed over and accelerated to 1.7 before starting to climb again. That was your max time to climb profile. The F-101 Voodoo actually has a higher thrust-to-weight ratio, and when I was at Hamilton AFB, our sister squadron had 101's. The two squadron commanders got up a little wager on

which airplane would be to the contrail level first. The two airplanes took off, and the 101 started outclimbing the 104 right away. Of course, the 104 driver just stayed low until he had point nine mach, then started up. He passed the 101 at about 20,000 and beat him to 35,000 handily!

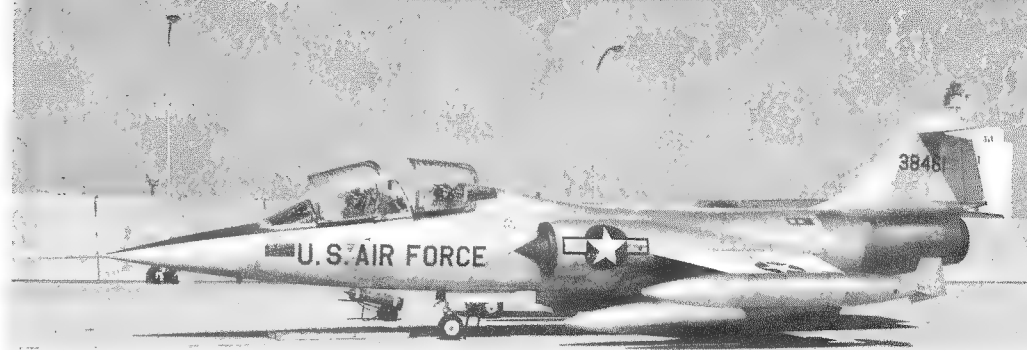
The trim in the 104 is slow, and that's to compensate for the very high speeds. It would do 800 knots indicated. You had a manual rudder...you pushed on cables, just like you do in a Piper Cub. It had a rudder lock, to keep the rudder from flopping at mach two. The yaw damper was separate surface, about a foot square, that sat just below the rudder. Normally you don't use the rudder until you are at very high angles of attack, in air combat situations, then you want to use the rudder as much as you can. Aileron performance is very impressive and as a matter of fact, when the flaps are up with the wing clean, it is limited to about two thirds travel to limit your roll performance, because it could wrap up very quickly. The stick feel is very heavy in pitch and the only way you could fight the airplane effectively...that is, at zero G, or max G, or at high angles of attack, is to have your thumb on the trim switch constantly. The guys who got real good with the airplane developed that technique.

The stall warning was artificial, and consisted of an eccentric weight on the stick, which would actually shake the stick when the airplane was approaching a stall. (Author's note: On more aerodynamically conventional airplanes, an airframe buffet will occur when a stall is approached, and thence be transferred to the controls.) If you ignored the "shaker", you encountered the "kicker", which was a hydraulic ram that actually kicked the stick forward when you didn't have the good sense to ease up yourself. The kicker could be overpowered with anywhere from 30 to 50 pounds of pressure, depending upon the model of 104. Both the shaker and kicker had a pitch rate input to them, so that if the pitch rate of the airplane went up quickly, they would fire early, just as you would get an accelerated stall in a conventional airplane.

The Starfighter is a very stable instrument platform, and I have flown it down to 200 foot ceiling and ½ mile visibility minimums with no problem. Again, you just have to get used to the higher approach speeds, and remember to anticipate your turns more.

During the time I spent at Hometown AFB, I ran the quality control program for the 104 squadron and I averaged about twenty test hops a month. On each of those I did an acceleration out to mach two, so I became very familiar with it's supersonic handling qualities. The inlet on the 104 was designed for 1.7 mach, and therefore, between .9 and 1.4 it had very little excess energy, and it took a little while to get to 1.4 But once you got there, the ducts started getting more efficient and at about 1.6 or 1.7 the engine went into what is called "T-2 reset", and the rpm went up about 3% to accommodate for the aerodynamic heating and give the engine better performance and stall margin. From about 1.4 to 1.8 the engine really seemed to come alive and the airplane stepped out like it was in passing gear. The limit on the airplane was mach 2, and that's an aerodynamic heating limit on the front frame of the engine. The actual airframe had directional stability out to about mach. 2.4.

I think the F-104 is probably the best airplane in the inventory for the dirty L/D missions, (Lift versus Drag) that we flew to simulate X-15 and Lifting Body approaches. We flew these missions in the USAF Test Pilot School at Edwards AFB. When you put the flaps down, the gear down, the speed brakes out, and pulled the engine back to idle, the 104 is the draggiest airplane that I know of, the L over D being somewhere in the of 2 to 1. The key to these missions was playing your airspeed, dive angle, and allowable lift perfectly to hit your



TF-104G of the 69th TFTS, 58th TFTW, Luke AFB Arizona photographed at Kelly AFB, Texas in April, 1973. [Norman E. Taylor]

desired aim point on the lakebed. You have only about 30 to 40 knots leeway between not being able to pull out, and pulling out too soon. In the former you hit the ground. Both have a tendency towards fatal results. It was a very interesting maneuver, and if you practiced alot and were fairly attentive, you could get pretty good. I got so that I could hit plus or minus ten knots and a thousand feet for touchdown from anyplace. Pete Knight, the X-15 Astronaut, was really impressive...he could hit plus or minus five knots and five hundred feet!

As you know, the 104 was designed by Kelly Johnson, in the "Skunk Works". The parameters of the design were set by the Korean War vets, who wanted an airplane that was faster than the other guy's...that would outclimb the other guy...that was small, with simple systems, and was best able to use the fighting element of surprise because of it's small size. (I think that if you study the history of air battles, you'll find that most of the kills were made from deep six...perhaps a ratio of six to one...out of the element of surprise.) Well, they got just what they wanted in the 104. The simple systems were the 20mm "gatling" gun, the Sidewinder missiles, and the twenty mile radar that was superlative from a hit-and-run tactics point of view. The simple start system was such that a scramble from an ADC alert barn would take on the average of two minutes. In fact, I remember one scramble I made when I was a young Lieutenant (and eager like all young lieutenants are) of a minute and forty five seconds, from the time the horn went off upstairs, down the firepole, into the airplane, and gear in the well! (The F-101's could do it in two minutes too.) But compare that to a lot of airplanes that take five minutes from the time you hit the start switches until they can fly, and it is still impressive.

The F-104 was the first airplane where a significant amount of supersonic formation flying was done, and there is a large section in the flight manual which discusses the effects of the shock waves that will suck you in, or push you out, depending upon where you are. It is a very good formation airplane...very solid.

A couple of the things about the 104 that really turned me on were it's looks of course, and the amount of excess thrust it had. If you tapped a burner at low altitude above 550 knots, you almost had more thrust than you knew how to handle. It was one of the few airplanes that, when you pushed the throttle up into the left hand corner, you were not asking for more than it could give you. I suspect that the F-15 and F-16 are that way, but this was the original



F-104A of USAF Test Pilot School, Edwards AFB, California. Overall light grey finish, white wings, natural metal rear fuselage. [Col. Don Kutyna]



F-104D performing the dirty L/D mission used to train pilots to fly the X-15 and lifting bodies. High Key was at 11,700 feet AGL, power to 80%, flaps to takeoff, speed brakes out, gear down, 295 knots in a 30 degree dive, then flare at 1400 feet AGL for a smooth landing. [Col. Don Kutyna]

lightweight fighter! Some of it's good news-bad news characteristics are centered around it's design. The single engine allowed the airplane to be very small and have tremendous acceleration. But if you lost that single engine, the airplane had the aerodynamics of a bathtub. Sub-sonic, with no engine, it just did not want to fly! The Oil System ran the exhaust nozzles (they were programmed to open or close according to throttle position). The exhaust would blow them open, but if you lost your engine oil, you couldn't maintain flight...you either had to get it on the ground now, or bail out. The airplane's supersonic drag was very low, which is impressive, but the bad news is that, that makes for low speed handling that is less than peachy keen. The high tail gave it low drag, but it also gave it pitch-up. It just did not like to fly at high angles of attack. Another impressive characteristic is the brake effectiveness. During my stint of quality control at Homestead, I went into a period of maximum braking, just to see what the airplane would do. It just so happened that we also had a Tac fighter wing of F-100's there at the same time, and it used to amaze the people out in the mobile control van with the difference in braking capability between my 104 and the 100's that they also saw every day. From the time to pitch out to touch down was about a minute and five seconds, and twenty seconds later, turning off the runway after a 3500 foot rollout. Those not familiar with F-104 performance thought it incredible. My technique involved using a combination of aerodynamic braking and the drag chute before getting on the brakes. Holding the nose off with full aft stick and trim, popping the drag chute at the same time, and setting the brakes. When the chute finally pulled the nose down, I would increase the brake pressure as the airplane slowed down. I did that for about three months, until one day I scrubbed a tire flat past the cord! Fortunately, it didn't blow, but I reserved my max braking efforts for special occasions after that. The brakes were not power assisted, and some people had trouble keeping the airplane from rolling when they did their engine runup prior to takeoff.

Another interesting thing about the 104...the wingtip mounted Tanks or Sidewinders actually acted as extensions or endplates, making the airplane more efficient in turns.

Cockpit design is the best I've ever seen. We had a man about 6'6", who was about three feet across, and we had a man 5'4", 110 lbs. Both of those people could climb into that airplane, adjust everything out, lock the shoulder harness, and reach every switch in the cockpit.

I don't think the 104 has ever been understood by the high level decision makers. It was well before it's time, and every biggie that ever rode in the airplane rode in the "B" model which, instead of having the extra gas needed to really demonstrate the airplane's capabilities, gave up better than 20% of it's internal fuel for the sake of the extra seat. Then of course, everyone wanted to go mach 2, so they would go out someplace, head back to the base at mach 2 and use up all their chemical energy to get the kinetic energy to go doublesonic. By the time they got back close to base, the low fuel level light was on, and they would conclude; "Hell, that airplane doesn't even have enough gas to fly an hour!" Well, you can't get energy like mach two and 65 to 70,000 feet without spending energy to do it...what they didn't realize is, once you get all that energy, you can do amazing things with it. I figured out one day that you could go 750 miles with a clean airplane at best cruise (.9 mach), but that if you climbed into your pressure suit and went mach two at 70,000 feet you could go 550 miles! Two hundred miles down the road you would be down

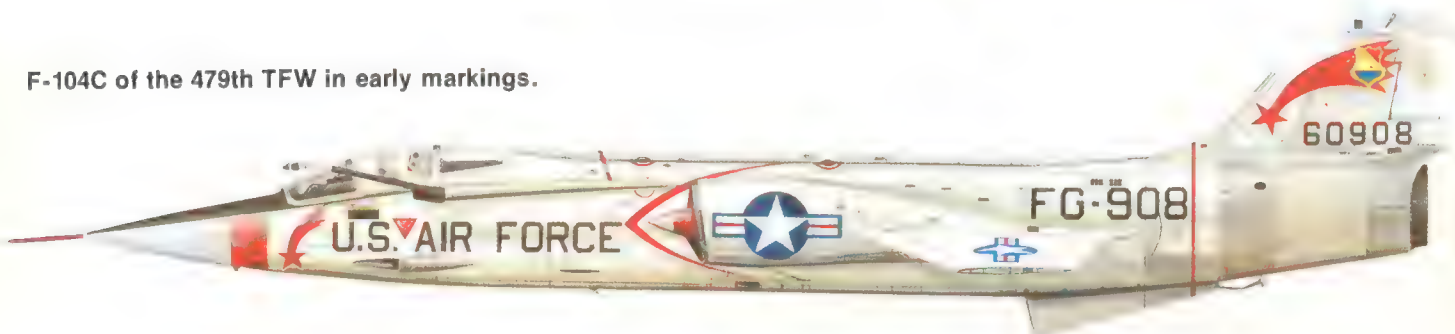
YF-104A Serial No. 55-2961 carrying civilian registration for it's duties as a NASA research aircraft from Edwards AFB, Calif.



F-104A of Royal Jordanian AF.



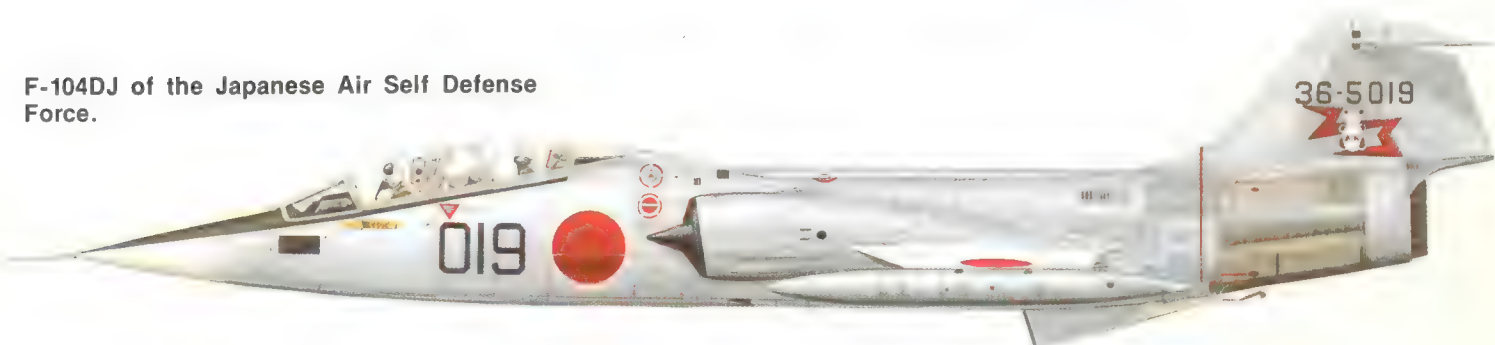
F-104C of the 479th TFW in early markings.



F-104D of the 198th TFS Puerto Rico ANG.



F-104DJ of the Japanese Air Self Defense Force.



F-104G of the Spanish AF's Escuadron 104.



CF-104G of the 439th Sqdn. Decorated for the 1969 European "Tiger Meet".



F-104G of the 6th Stormo, 154 Gruppo, Italian AF as it appeared at Ghedi AFB, Italy, 1972.

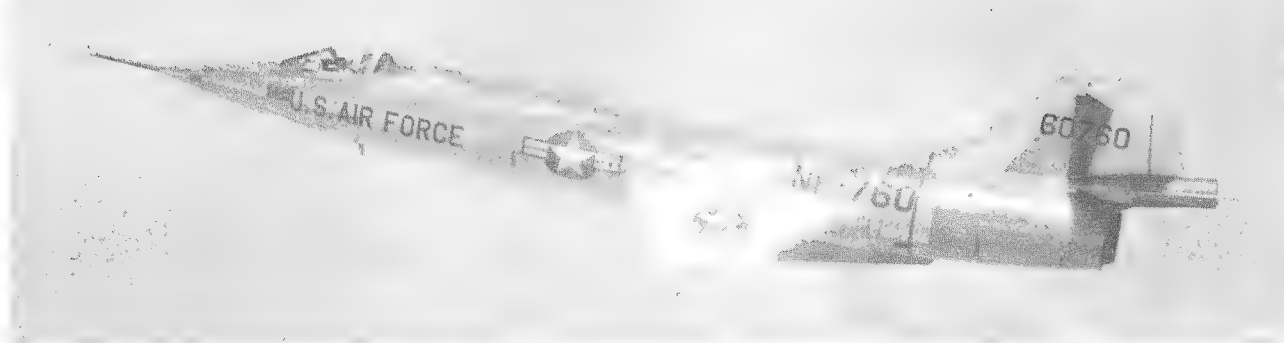


F-104G of the West German Navy. Marinefliegergeschwader 1, Jagel with AS 20 missiles.



F-104G of the 320th Sqdn. Royal Netherlands AF, as it appeared in 1974.





NF-104 was used at USAF Test Pilot School for zoom flights to 103,000 feet. It mounted an LR-121/AR-2 Rocket Engine under the "G" model tail, which was used during run-in and initial climb portions of the flight. [Col. Don Kutyna]



Close-up of NF-104A Rocket Engine. Burn time of rocket was two minutes, starting at 35,000 feet and mach 1.9 and burning out at 100,000 feet. 104's jet engine was shut down at 80,000 feet and restarted on the backside of the curve, below 60,000 feet. [USAF via Taylor]



Other modifications to NF-104A included new shock cones at intakes to accommodate higher mach numbers, and metal nose cone which carried RCS controls for pitch & yaw control. [Col. Don Kutyna]

to 2,000 pounds of gas, but you could go the next 350 miles on about 1,000 pounds of gas! When TAC got the 104, they tried to make an air-to-ground fighter out of it, instead of sticking to the air superiority role, and it wasn't designed for dropping bombs. I just don't think the Air Force ever properly understood the airplane. It was, after all, the original lightweight fighter!

Colonel Don Kutyna has flown a number of different aircraft--more than 25--during his Air Force career. They ranged from gliders to heavy bombers, most of the century series fighters, and included a combat tour in the F-105. While his time in the F-104 was relatively limited (300+ hours) it was spent as an instructor at the Aerospace Research Pilot School (ARPS) where the F-104 was routinely flown to the limits of its performance. These are his comments on the Starfighter.

Of all the airplanes I have flown, the F-104 was the most exciting and rewarding. "Exciting" because of its great performance, and "rewarding" because the limits of that performance took a great deal of skill to reach. This

is not to say that you couldn't amble loosely around the sky in the 104 without getting hurt-you could. But, to get the maximums available at the edges of the Starfighter's envelope took a lot of skill, concentration, and plain hard work. When you came down from a good mission and logged those six or seven tenths of an hour you generally had the very satisfied feeling that you had well earned the time.

From another aspect, the 104 was an airplane in which you could bust your tail quicker than any other I've flown. It just did not allow you many mistakes! Other aircraft, including century series, generally give a good deal of warning that trouble is approaching and ample time to ward it off. Not the 104--make a critical error, and by the time you've noticed the goof it's often too late to recover. When I say "critical" I mean errors like improper configurations--flap positions, speed brake extensions, throttle settings, etc. For example, forget your flaps on the turn to final in a T-Bird or Thud, and the airplane will start to shake, rattle, and roll long before you're in any real danger and with plenty of

opportunity to correct the error, widen the pattern, and/or take it around. Forget the flaps in a 104 and yank it into a tight base turn and it can get behind the power curve and pay off well before a surprised jock can realize he's in trouble and apply the proper corrective action. In recognition of its demanding characteristics, very few if any brand new pilots were assigned directly to the 104. The Air Force generally let them cut their teeth on the less critical fighters before providing a set of Starfighter spurs.

While I'm anything but a great combat air ace and the closest I ever got to a Mig was to shake Steve Ritchie's hand, I did have the best group of teachers ever assembled in the students and test pilots at Edwards. They taught me a great deal about hassling in a 104. It was a beautiful plane to employ in a fight. From any angle its silhouette was very small and difficult to see, and yet the 104 itself had the best visibility of any supersonic bird after the F-86 and before the F-15. It had great performance; and, while it admittedly wasn't much of a turning machine, supersonically it got around corners quite well and could out zoom just about anything. To this day, excepting the F-15 and F-16, many of the pros would still take the 104 (particularly with the -19 engine) as a pure clean air mass visual fighting machine over any other fighter in the inventory.

The combination of performance, visibility, and invisibility made it a dream to fight in. For example, in rat racing with an F-4, often all you had to do was to play the vertical. If the Phantom was behind you on the way up, all those throttles, engines, fuel tanks, and pilots he was saddled with usually required him to start back down before the 104 did--and of course in such a game, first one down automatically assumes the lead. Also, there was no comparison in seeing and being seen. The 104 was small and clean, while the barn door, smoke belching profile of the F-4 blots out half the sky.

However, like any other fighter, to realize the full capabilities of the 104 you had to know and use its relative advantages. A few of those who didn't think it was much of an air-to-air machine often thought so because they would be led into playing the other man's game. A T-38 for example could climb with a 104 and would turn rings around it. But, a 38 is limited to about 1½ Mach, while at Mach 1.4, the 104 is just starting to get good. Obviously, the way to play a 38 is to not turn with it, but rather to get the 104 to Mach 1.4+ and start a slashing attack, trading Mach with a zoom for altitude at each pass. The 38 could stay low turning circles all day but would never get a shot in, while often losing sight of the 104 and allowing a clean, almost panel strafing pass by the Starfighter.

As an aircraft at the leading edge of technology the F-104 had many unusual characteristics. One of these was that at high Mach numbers the engine emitted a lot of wierd noises...groans, howls, screams, etc. It was all quite normal, but a pilot who hadn't had the experience often got somewhat concerned the first time around. In any other airplane those kinds of noises usually meant trouble. You got used to it after a while, and hoped that you could recognize the bad from the good amidst all that racket.

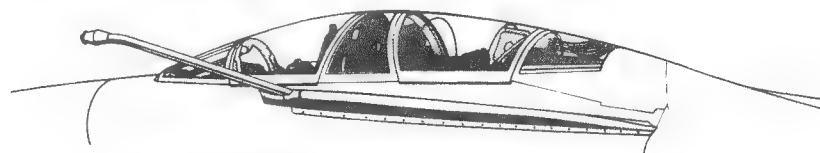
Of all the missions I have ever flown-including combat-the zoom flights in the rocket powered NF-104 were the most demanding. There was more to do and you had to practice harder to get optimal results on that flight than on any other flight I've had. You could get through the mission OK with a little sloppiness, but if you wanted to get the maximum out of the airplane you really had to have the entire procedure and technique darn near perfect from start to finish. It took countless hours in the simulator and a lot of cockpit time just thinking through the mission. But the end result, a zoom to 100,000 feet

plus was well worth it.

In a different category, the low L/D missions in the F-104 simulating lifting bodies were perhaps the hairiest we flew in the school. During my stay, it seemed like every time we got a new Commandant at ARPS he was greeted by an F-104 accident-the majority of which were low L/D related.

The parameters of the mission were very critical, and the 104 in the dirty L/D configuration with everything hanging out and the engine pulled back had a glide ratio of about 2.2 to 1. Compare this to a T-33 at about 14 to 1, a civil jet transport near 17 to 1, or an average glider at 35 to 1 and you get some feel for the rate of descent of a dirty 104. Even the aptly named "Thud" had a better glide ratio at 7 to 1! The dirty 104's 2.2 to 1 didn't give you much tolerance in pulling out for a flare and touchdown. What the maneuver consisted of was basically a 30 degree dive bomb run with a pull-out which left your gear down on the runway at your bottom out altitude. It was interesting to take an experienced fighter pilot on his initial demonstration of the L/D mission, pull the throttle back, hang out all the garbage, hold 295 knots, and then go into a 30° dive with a pullout commencing at 1400 feet above the ground. The non-fighter pilots who didn't know any better often sat blandly through it, but the guy who had routinely hurled his body at the ground on the range-but at 500 knots with a relatively clean bird-and who recognized the criticality of the maneuver, would often start to fidget in his seat the closer he got to the ground. He was going to "guts you out", but I guess he would sort of wonder if that numb-nut IP in the back seat really knew what the heck he was doing. It was a very critical and demanding maneuver, but the experience we gained in practicing it and the related research in the NASA lifting bodies will soon begin to pay off as the Space Shuttle with its similar landing approach becomes operational.

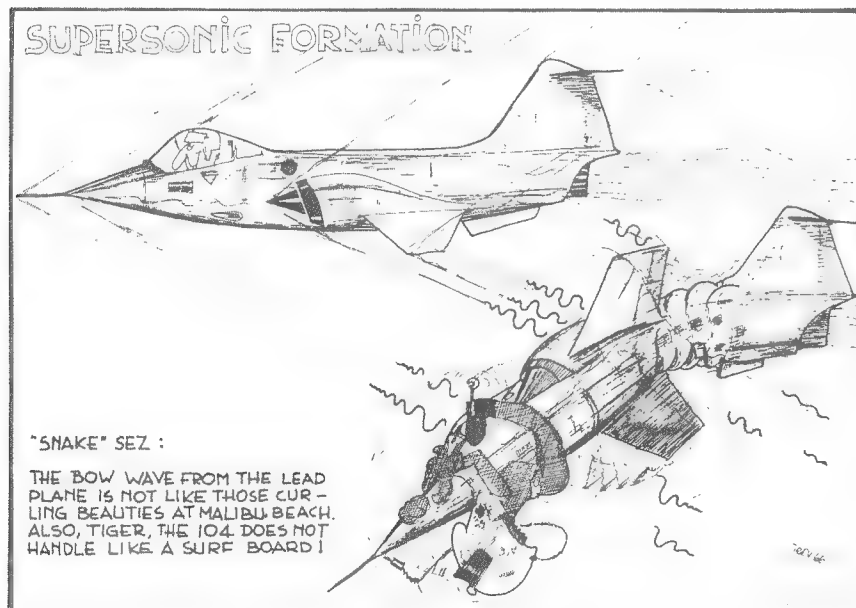
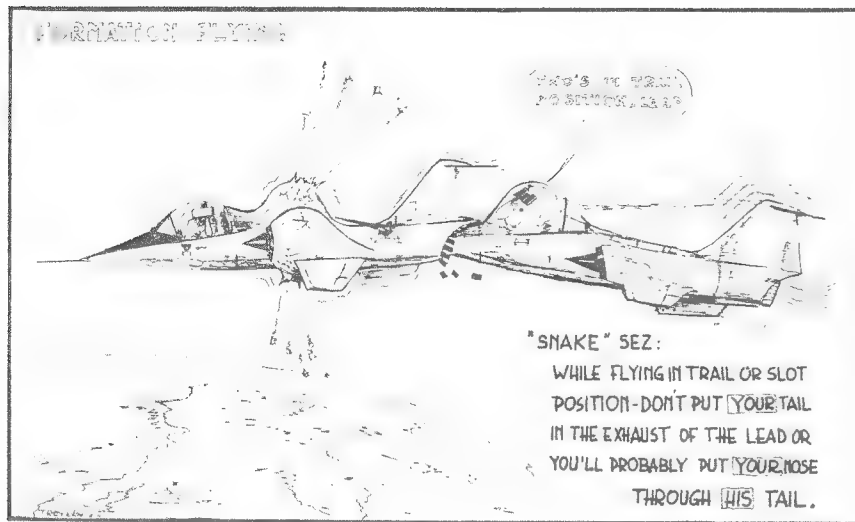
I guess I could summarize by saying that unlike many of the multi-purpose fighters we have managed to build, the F-104 was really an optimized machine-specifically designed for high speed performance. It was much like a pure "for track use only" race car. You put it on the street in traffic and it doesn't really shine amongst the various "sporty" cars around, but get it in its element, a fast track and unlimited sky, and nothing of its day-and several days beyond-could touch it.



F-104D Canopy



F-104G Canopy

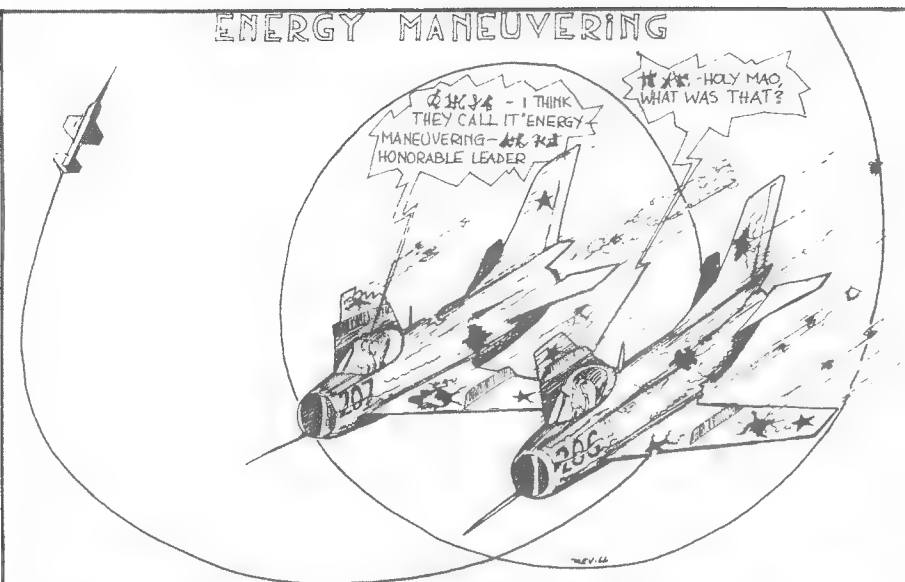


In 1961, Lockheed Director of Flying Operations Tony LeVier, realizing the need for more direct pilot support, prevailed upon his bosses to fund such a program. It was originally named Operational and Engineering Reliability Team. In 1963 it was renamed Starfighter Utilization and Reliability Effort Team G.L. "Snake" Reeves, Lockheed test pilot, managed the team and wrote the Project SURE books. The books, which taught 104 pilots the refinements of flying the "Silver Sliver," were illustrated with cartoons by P.P. "Pete"



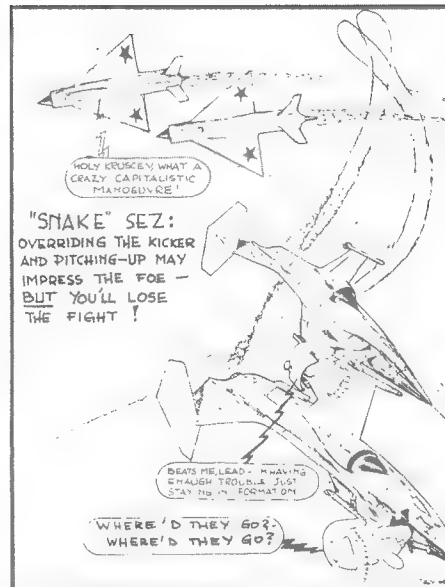
Trevisan, FIAT test pilot. The cartoons, some of which are shown on these pages, put across the most cogent points in a way that pilots could appreciate. The Project SURE books filled in the gaps in a pilot's basic knowledge. In "Snake" Reeves' own words; "The Pilot's Handbook tells you **what** to do...not **why for** or **how come**." SURE was Lockheed's effort to provide support for 104 pilots, much as they had provided support for P-38 pilots in World War II.

ENERGY MANEUVERING



"SNAKE" SEZ: TIGERS, THE NAME OF THE GAME IS A HIGH MACH AND CLEAN FANGS!

JET WASH





QF-104A, sporting bright red/orange paint on fuselage, was photographed at McClellan AFB in October, 1967 by Norman E. Taylor. [via Paul Stevens]



QF-104A-1-LO, of the 3205th Drone Sqdn., Auxiliary Field #3, Eglin AFB, Florida, September, 1964. Note AFSC badge and various mission symbols, which appear to be silhouettes of other RPV's. [Norman E. Taylor]



QF-104A-1-LO, also of the 3205th at Eglin. [Norman E. Taylor]

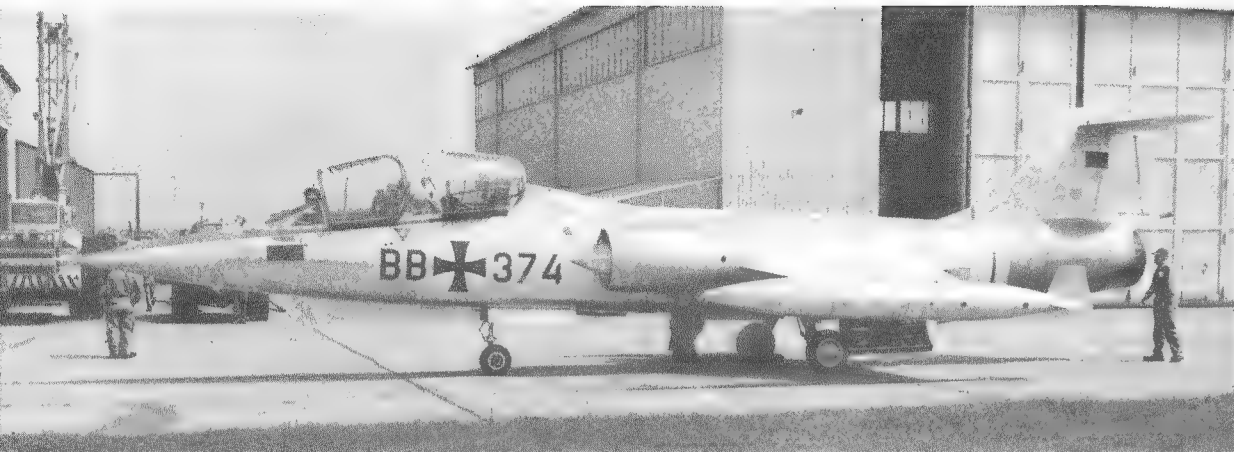


F-104A-20-LO served with the 4760th CCTS at Webb AFB, Texas before being mothballed at Davis-Monthan AFB, Arizona. It was earmarked for delivery to the Royal Jordanian Air Force when photographed in 1969 by Norman E. Taylor.



F-104C-5-LO, serial number 56-0926, of the 198th TFS, Puerto Rico ANG, at Shaw AFB, South Carolina, July, 1973. PRANG was the last USAF unit to

operate the 104 in regular service. They gave up their 104's in 1975. [Norman E. Taylor]



F-104F of the West German Luftwaffe at Hahn AB in 1961. 30 "F" models were built by Lockheed for the Germans, and were used as trainers. They were basically the same as the "D", and did not have the 20mm cannon or NASARR system. [David Menard]



F-104G of the Luftwaffe's JaboG 32. [Michel C. Klaver]

West Germany's decision to replace its F-84's and F-86's with the Starfighter was based upon competitive analysis of the 104 against the French Mirage and the Grumman Super Tiger, a derivative of the F-11 design. The Starfighter enjoyed a wide margin of superiority over its competitors, and this convinced the Germans that it could perform strike and reconnaissance duties in addition to its demonstrated capability as an interceptor. The multi-mission F-104 embodied several design changes from the F-104C being operated by USAF, among them: Structural upgrading to allow low level high speed penetration and bomb carrying capability, sophisticated avionics which would permit air-to-air and air-to-ground target acquisition and tracking, and all-weather bombing capability. Unfortunately, several circumstances combined to make the 104 something of an enigma as far as West Germany was concerned. On the one hand, the outstanding performance of the 104 could not be denied. On the other hand, the Luftwaffe could not seem to avoid crashing 104's at an alarming rate. The sophisticated avionics which made the 104 an all-weather performer were themselves very sensitive to German weather and required the kind of maintenance that the inexperienced Luftwaffe ground crews were not able to provide. The Starfighter's performance was sometimes more than the low-time Luftwaffe pilots could cope with, especially given the unforgiving nature of the beast. Altogether, the Luftwaffe has lost 178 starfighters as of this writing. Strangely enough, the West German Navy, which resisted assignment of the 104 mightily, has had relatively little trouble with its Starfighters. Likewise, the other NATO nations which operated the 104 did so with a fraction of the trouble that the Luftwaffe experienced. The Luftwaffe suffered through the teething problems of the Starfighter, and its experiences undoubtedly served to make other country's F-104 transition smoother.



TF-104G of AKG 51. Luftwaffe 104's carried camouflage pattern of green and gray. [Michel C. Klaver]



F-104G of the West German Navy's MFG2, at Kiel, July, 1975. West German Navy 104's latest camouflage is overall gray top, light gray bottom. [Michel C. Klaver]



F-104G of JaboG 34 at Memmingen AB, Germany, June, 1971. Bands on wing tanks were dayglo orange upon initial application, but faded to light yellow as

it weathered. [D. Hughes via Norman E. Taylor]



TF-104G of AKG 52 at RAF Woodbridge in August, 1969, for that year's "Tiger Meet". [Above Left] [G. Pennick, via Norman E. Taylor]

TF-104G of WaSlw 10 at Upjever AB in August, 1975. Dioramist' take note! Camouflaged [green and brown] hanger in background. [Gunter Grondstein] [Above] JaboG 32 F-104G. German Starfighters were the first to incorporate fully blown landing flaps which, incidentally, could be used for maneuvering, providing a turn radius reduction of one third at 5,000 feet. The F-104G is capable of reaching Mach 2 at 50,000 feet in less than eight minutes from brake release. Impressive credentials for a twenty year veteran! [Michel B. Klaver]

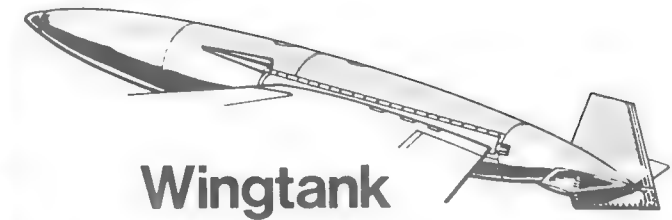


Starfighter Units in Europe - 1975

Country	Unit (Sqn)	Role	Base	Identity code (If Worn)	Replaced by (If)	Country	Unit (Sqn)	Role	Base	Identity Code (If Worn)	Replaced by (If)
BELGIUM	349	Interceptor	Beuavechain			ITALY	18 Gr.	Recce	Villafranca	3 - 3rd Stormi (Wing)	
	350	Interceptor	Beauvechain				28 Gr.	Recce		3 -	
	23	Fighter/Bomber	Kleine Brogel				132 Gr.	Recce		3 -	
	31	Fighter/Bomber	Kleine Brogel				9 Gr.	Interceptor	Grosseto	4 - 4th Stormi	
CANADA	421, 439, 441	Interceptor/Recce	Solingen	note: CAF Nato Assignment			23 Gr.	F/B	Rimini	5 - 5th Stormi	
					102 Gr.		F/B	Rimini	5 - 5th Stormi		
DENMARK	723 726	Interceptor Interceptor	Aalborg Aalborg		154 Gr.		F/B	Ghedì	6 - 6th Stormi		
				10 Gr.	Interceptor		Grazzanise	9 - 9th Stormi			
GERMANY (W)	Jabo31	F/B	Norvenich	DA until 1968			22 Gr.	Interceptor	Istrana	51 - 51st Stormi	
	Jabo32	F/B	Lechfeld	DB until 1968			155 Gr.	Interceptor	Istrana	51 - 51st Stormi	
	Jabo33	F/B	Buechel	DC until 1968			156 Gr.	Interceptor	G. del Colle	36 - 36th Stormi	
	Jabo34	F/B	Memmingen	DD until 1968			12 Gr.	Interceptor	G. del Colle	36 - 36th Stormi	
	Jabo36	F/B	Hopsten	DF until 1968			21 Gr.	Interceptor	Cameri	53 - 53rd Stormi	
	AKG51	Recce.	Bremgarten	EA until 1968	RF4E	NETHERLANDS	306	Recce	Volkel		
	AKG52	Recce.	Leck	EB until 1968	RF4E		311	F/B	Volkel		
	JG71	Interceptor	Wittmundshafen	JA until 1968	F4F		312	F/B	Volkel		
	JG74	Interceptor	Neuberg	JD until 1968	F4F		322	Interceptor	Leeuwarden		
	WasLw10	Training	Jever	BB until 1968			323	Interceptor	Leeuwarden		
NAVY	MFG1	Strike	Schleswig	VA until 1968		NORWAY	331	Interceptor	Bodo	FN until 1973	
	MFG2	Strike	Eggebeck	VB until 1968			334	Interceptor	Bodo		
GREECE	335	Interceptor	Tanagra			TURKEY	141	Interceptor	Murted		
	336	F/B	Araxos				191	F/B	Balikesir		
						SPAIN	104	Interceptor	Torrejon	Squadron No.	F4C

F-104G of TAC sporting the bicentennial paint scheme adopted for the occasion of TAC's thirtieth anniversary. Langley AFB, March 1976. [Dave Menard].





Wingtank

Fiat-built F-104S shown on this page was an outgrowth of the Lockheed CL-901 and used an uprated J79 engine, which gave much improved performance, including upgraded top speed of mach 2.2. It also incorporated fire-control radar capable of guiding the Sparrow missile. It was originally intended as the ultimate in Starfighter interceptors, but true to form, military planners insisted on hanging bombs on the additional hardpoints. It was dubbed "Super Starfighter" by the Italians. [Lockheed]





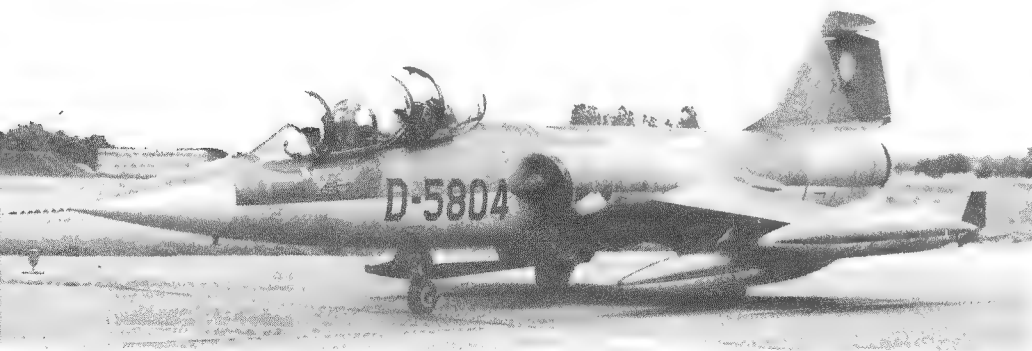
Dutch Starfighter [TF-104G] being offloaded from aerial freighter during delivery of initial complement of 104's. [Michel B. Klaver]

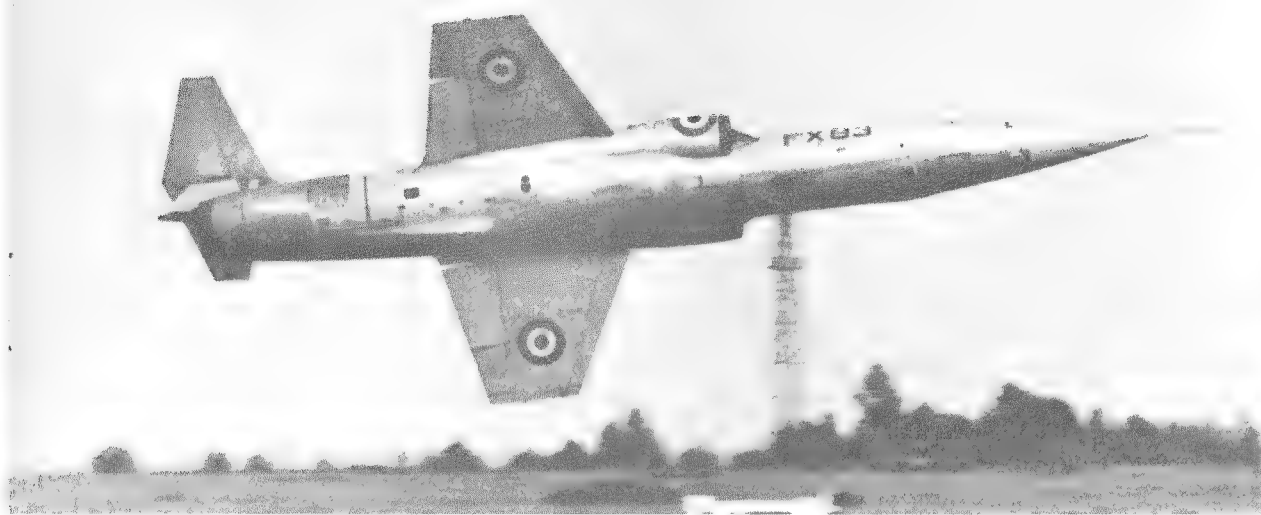


RF-104G of 306 Squadron, Royal Netherlands Air Force, at Twenthe, March, 1975. Vulcan cannon is replaced by ventral camera fairing, just aft of nose gear, on RF-104G's. [Michel B. Klaver]



TF-104G of the RAAF, landing upon delivery to Ypenburg in 1964. [Above] TF-104G of RAAF Operational Conversion Unit, the "Dutch Masters", at Twenthe. Orange triangle with black cap on vertical fin. [Above Left] TF-104G of RAAF OCU. [Left] The Dutch operate five squadrons of 104's, two Interceptor [322, 323] two fighter-bomber, [311, 312] and one reconnaissance. [306] [Michel B. Klaver]





Belgian Air Force Lt. Col. Bill Ongena makes a low altitude, high speed roll during air show at Beauvechain AB, Belgium, 1966. [Lockheed]



F-104G of 31st Squadron, Belgium AF at Leuchars July, 1966, for "Tiger Meet". [S. Peltz via Norman E. Taylor]



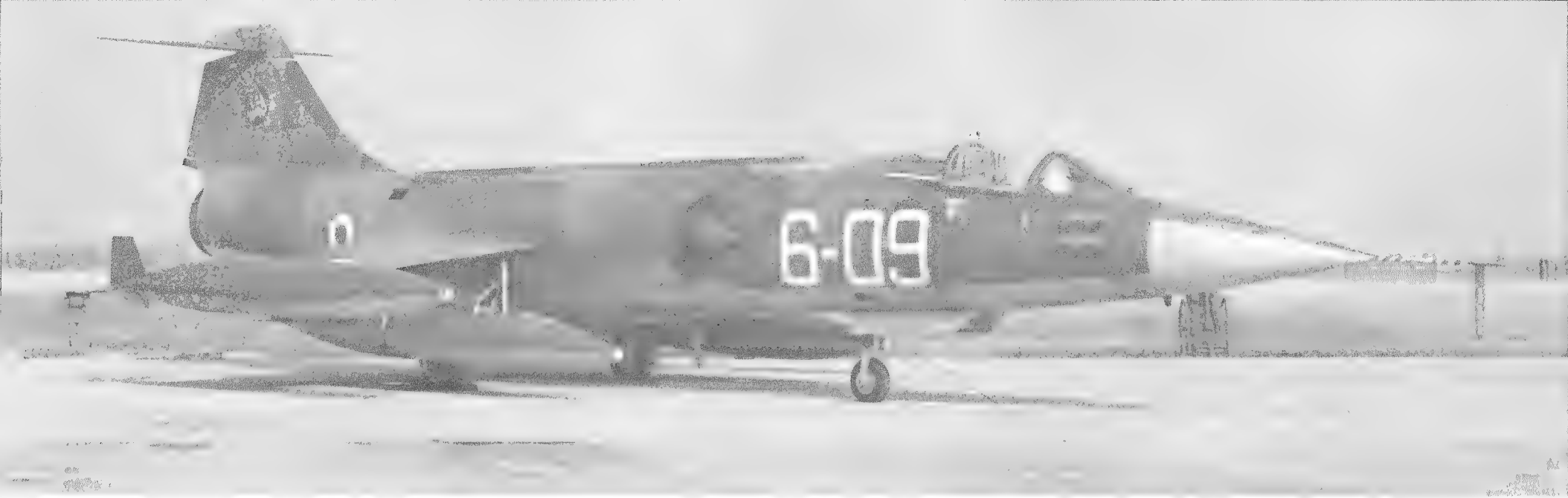
Pair of Belgium 104's make a formation takeoff. The F-104 compiled the best safety record of any Belgian combat aircraft in the 60's. [Michel B. Klaver]



F-104G of the Royal Belgian Air Force's 10th Fighter-Bomber Wing rolls out with drag chute deployed. [Michel B. Klaver]



10 FBW 104, with practice bomb dispenser fitted on centerline, and rocket pod on wing station. Belgian camouflage colors are Green 24064 [dark] 24102 [light] tan 20219, and light gray 26622. Belgium operated four Starfighter escadrilles, 23 & 31 at Kleine Brogel in the fighter-bomber role, and 349 and 350 at Beauvechain in the interceptor role. [Michel B. Klaver]



F-104G of the 6th Stormo, 154 Gruppo, Italian Air Force, at Ghedi AFB Italy in October, 1972. [see color side view painting] [L. Hansen via Norman E. Taylor]



F-104G of the 53rd Stormo, 21st Gruppo, Italian Air Force in 1974 Tiger Meet markings. [Left] TF-104G of 20th OCU Gruppo, IAF. [Right] The Aeronautica Militare operated 104's with two interceptor Gruppi, [9 & 10] three

fighter-bomber Gruppi [101, 102 & 154] and one Tactical Reconnaissance Gruppo. [103] [Michel B. Klaver]



TF-104G of Denmark's Danske Flyvevaben. National markings consist of red and white roundel, [wings and fuselage] and red pennant with white cross. [vertical fin] [Michel B. Klaver]



723 and 726 Eskadrillerne operates the F-104G out of Aalborg. Note Hunter and F-86D in the background. [Michel B. Klaver]



F-104G on final approach. Note pair of Sidewinders mounted under fuselage. [Michel B. Klaver]



CF-104G in Danish warpaint, which is overall dark green. [Michel B. Klaver]

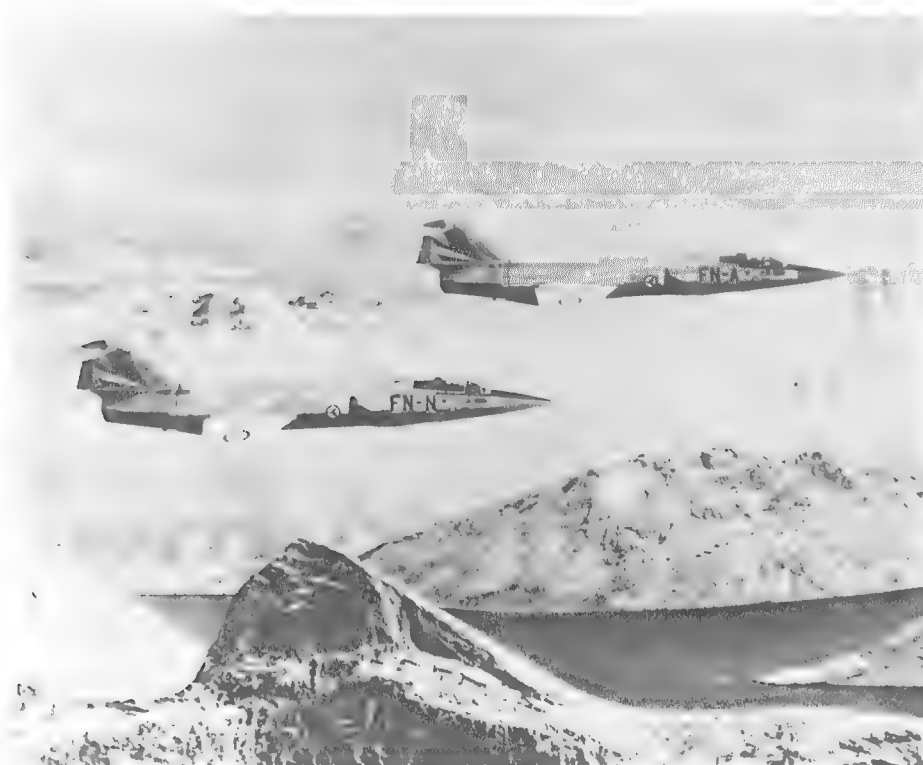


Dark green camouflage of Danish 104's had a tendency to show weathering to a greater extent than other schemes. [Michel B. Klaver]



RF-104G of 331 Squadron, Royal Norwegian Air Force. It would appear that this "RF" still mounted the 20mm Vulcan cannon, since the cannon fairing is not installed. Tail flash is red, white, and blue from top to bottom. [top] 331

Skvadron is sole Norwegian 104 unit, operating from Bodo. Camouflage schemes range from natural metal to dark green overall, to aluminum paint overall. [Norman E. Taylor, Michel B. Klaver, Gunter Grondstein, Lockheed]

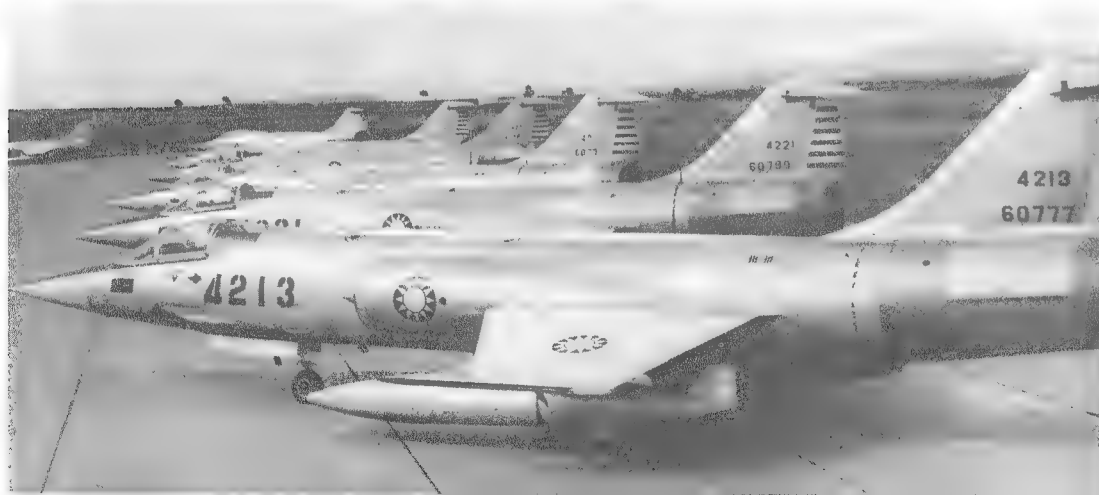




F-104G's of Greece's Royal Hellenic Air Force retained their USAF serial numbers and buzz numbers. 104 above belonged to 335th Squadron and is seen here at Taragra AB, Greece, in June, 1970. Camouflage is standard USAF. Greece operated two F-104 interceptor squadrons. [S. Peltz via Norman E. Taylor and Michel B. Klaver]



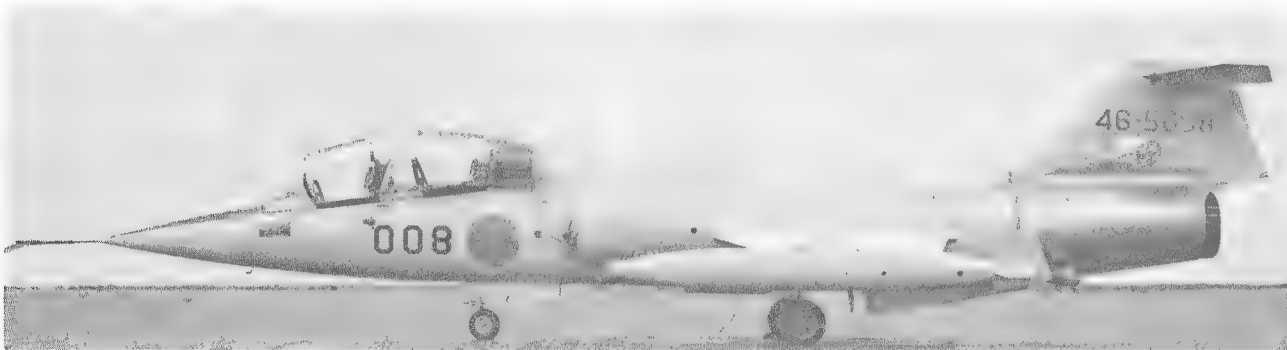
F-104G of the 4th Wing, Turkish Air Force, at Murted AB, Turkey, June, 1970. Overall light gray finish, red and white national markings. [S. Peltz via Norman E. Taylor]



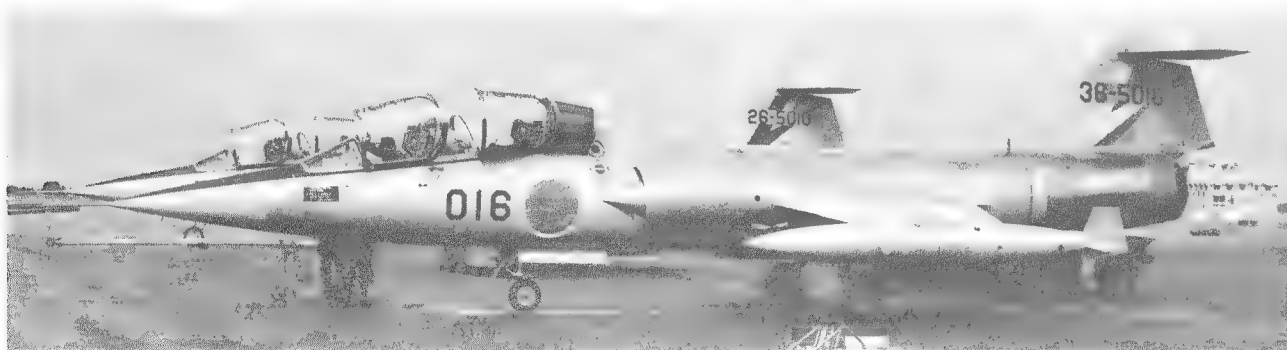
F-104G's of the Turkish Air Force's 141 Squadron. Note that these Starfighters carry the earlier national marking on the fuselage, which consisted of a red/white/red roundel. Aircraft above has access panels open for servicing of avionics. F-104G carried the NASARR F-15AM-11 radar, which allowed it to perform all-weather bombing missions. [Above Left and Right] [Michel C. Klaver] F-104A's of the Chinese Nationalist Air Force. The Chinese were among the first foreign air forces to operate the Starfighters, receiving 25 from USAF in 1959. Several unconfirmed reports indicate that the Chinese were among the first to engage Migs with the Starfighter. [Left] [Norman E. Taylor]



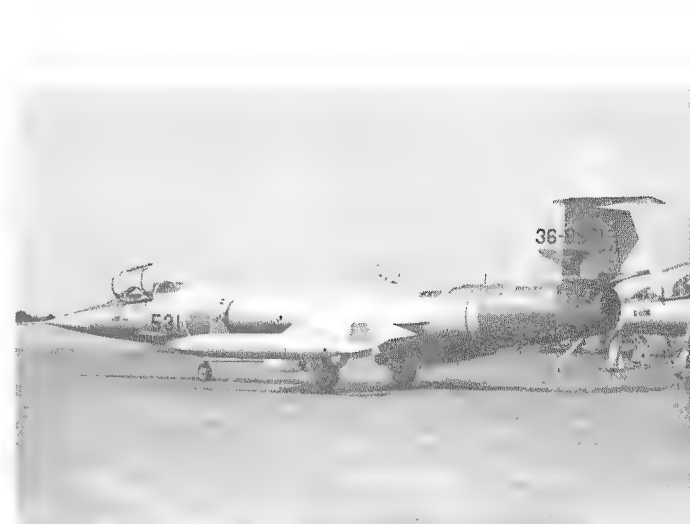
F-104DJ of the 207th Squadron, Japan Air Self Defense Force, landing at Naha AB, Okinawa in 1973. The Starfighter was license built in Japan by Mitsubishi. [S. Ohtaki via Norman E. Taylor]



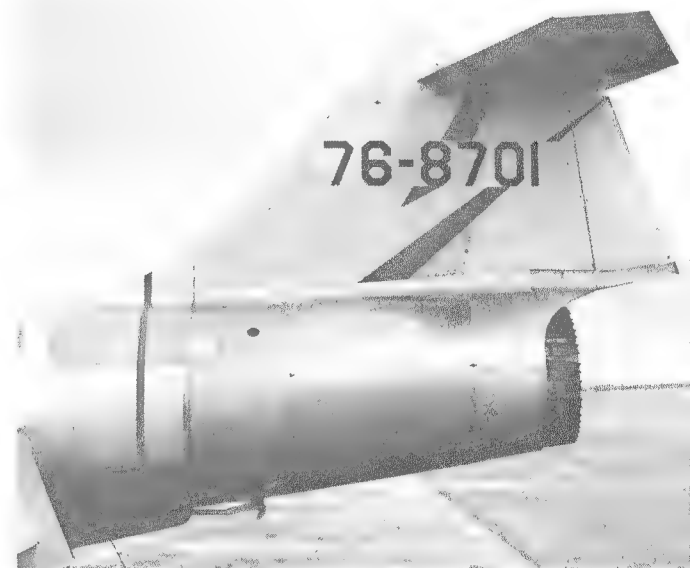
F-104DJ of the 207th Squadron, 83rd Air Group, based at NAHA AB, Okinawa, as it appeared in 1975. The Japanese Starfighters have been christened with the popular name "Eiko" [Glory]. [Norman E. Taylor]



F-104DJ of the 202nd Squadron, 5th Wing, based at Nittabaru AB, Japan, as it appeared in September, 1974. Most Japanese 104's were painted aluminum, with white wings. [Norman E. Taylor]



F-104J of the 205th Squadron 6th Wing, Komatsu AB, Japan, at Misawa AB, Japan, Aug. 1975. [Norman E. Taylor]



Tail details of F-104J of the 202nd Squadron. Japanese 104's because of the required defensive posture of JASDF, had their NASARR avionics optimized for the air-to-air combat role. [Norman E. Taylor]



CF-104G of the 439th Squadron, RCAF, at Leck AB, Germany, June, 1967. Canadian 104's did not carry the Vulcan cannon, being intended for use as air-to-ground combat aircraft. As such, they carried the R-24A NASARR,

optimized for bombing. Note the Vicon photo-reconnaissance pod, housing four 70mm Vinten cameras, on fuselage centerline. [D. Hughes via Norman E. Taylor]



CF-104G at RAF Alconbury in 1967. Most Canadian 104's had polished aluminum finish with white wings. [David Menard via Paul Stevens]



CF-104G at Baden Soellingen, AB, Germany, July 1972. Latest scheme for 104's of Canadian Armed Forces is dark green camouflage overall. [L. Hansen via Norman E. Taylor]



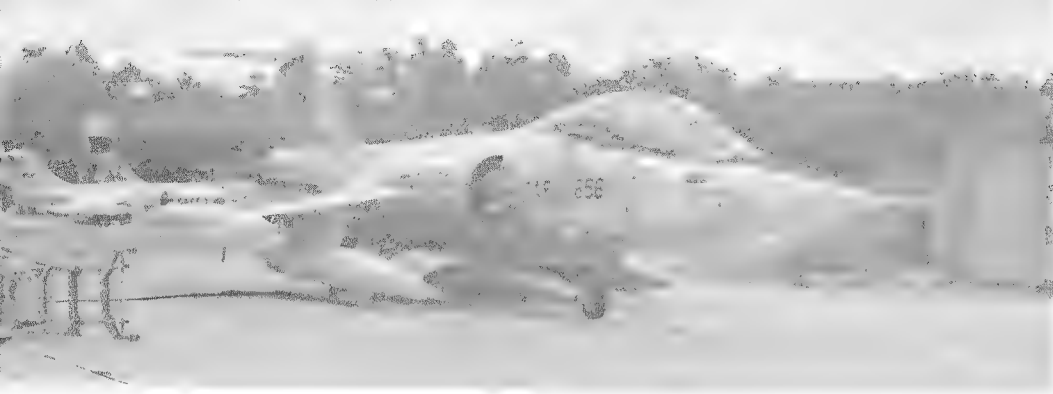
CF-104G of 439th Squadron, CAF, at RAF Woodbridge in August, 1969. It is shown in it's 1969 "Tiger Meet" warpaint. [also see color profile] Removal

of Vulcan cannon from Canadian 104's added 101 gallons of internal fuel. [G. Pennick via Norman E. Taylor]



CF-104D of the CAF at RAF Yeovilton in September, 1970. Canadian Starfighter was selected as RCAF replacement for the Canadair Sabre, in 1959. The CF-104 was also built by Canadair, which also built Starfighters for other

NATO nations under USAF's Military Assistance Program. [Abbot Hafter via Paul Stevens]



CF-104D of CAF at Baden Soellingen, German, July, 1972. Canadian built Starfighters were delivered to Norway, Denmark, Greece, Turkey, and Spain. [L. Hansen via Norman E. Taylor]



CF-104D of Canadian Armed Forces at 1974 "Tiger Meet". Canadian Starfighters are powered by the license built Orenda J79-OEL-7. [Michel C. Klaver]



CF-104G rolls out after landing. It mounts a practice bomb dispenser on the centerline. [C. Joos via Norman E. Taylor]



RF-104G is recognizable by slight bulge under fuselage, just aft of nose gear doors. It is unarmed and carries three cameras in fuselage. Cameras are fully automatic and can be operated by the pilot, through use of trigger on control

stick grip. F-104G's were modified by Avio Diepen at Ypenburg to RF configuration, and some were built as RF's by Fiat in Italy. [Lockheed]

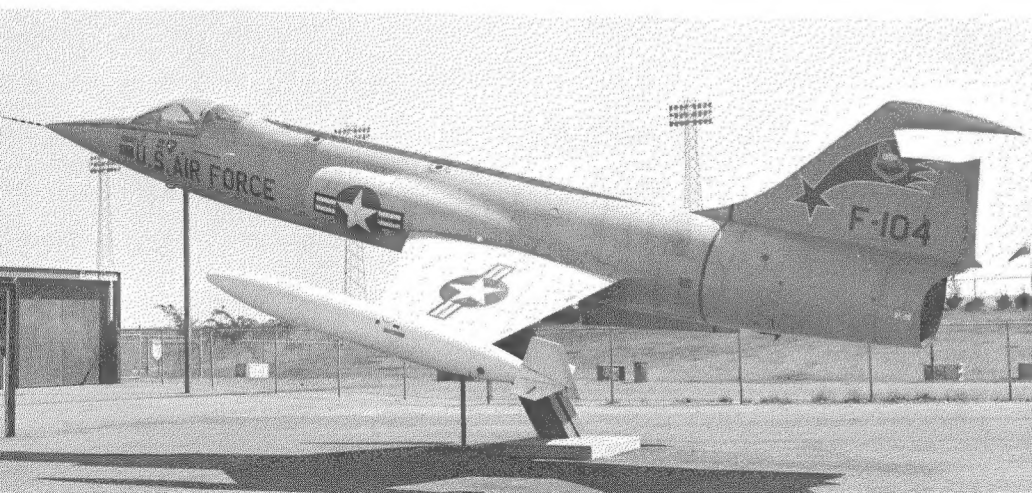


Lockheed's CL-901 "Super Starfighter" became the prototype for Italy's F-104S. It used the J79/J1Q engine, which gave 17,900 lbs. thrust, an increase

of 2100 lbs. over previous Starfighter variants. [Lockheed]



F-104C-5-LO in Puerto Rico ANG markings...the last USAF combat markings carried on the Starfighter. [Paul Stevens]



F-104A-20-LO [serial number 56-801] on display at Cal-Expo in August 1972. [Left] [Dave Menard] F-104A on display at Air Force Academy. [Right] [Royal Frey via Norman E. Taylor] The Starfighter retired from USAF combat service in 1975, and will likely be retired in foreign service within the next five years. It lived to see the concept it had so effectively advocated...that of the lightweight fighter...gain widespread acceptance, and a worthy successor is now in the offing. The F-16 air combat fighter will enter service in the 1980's...just about the time the Starfighter celebrates it's thirteenth birthday. It doesn't look it's age, and displays like those shown on these pages will fire the imagination of future generations of fighter pilots, as they wonder what it was like to fly the "Manned Missile".





Aircraft

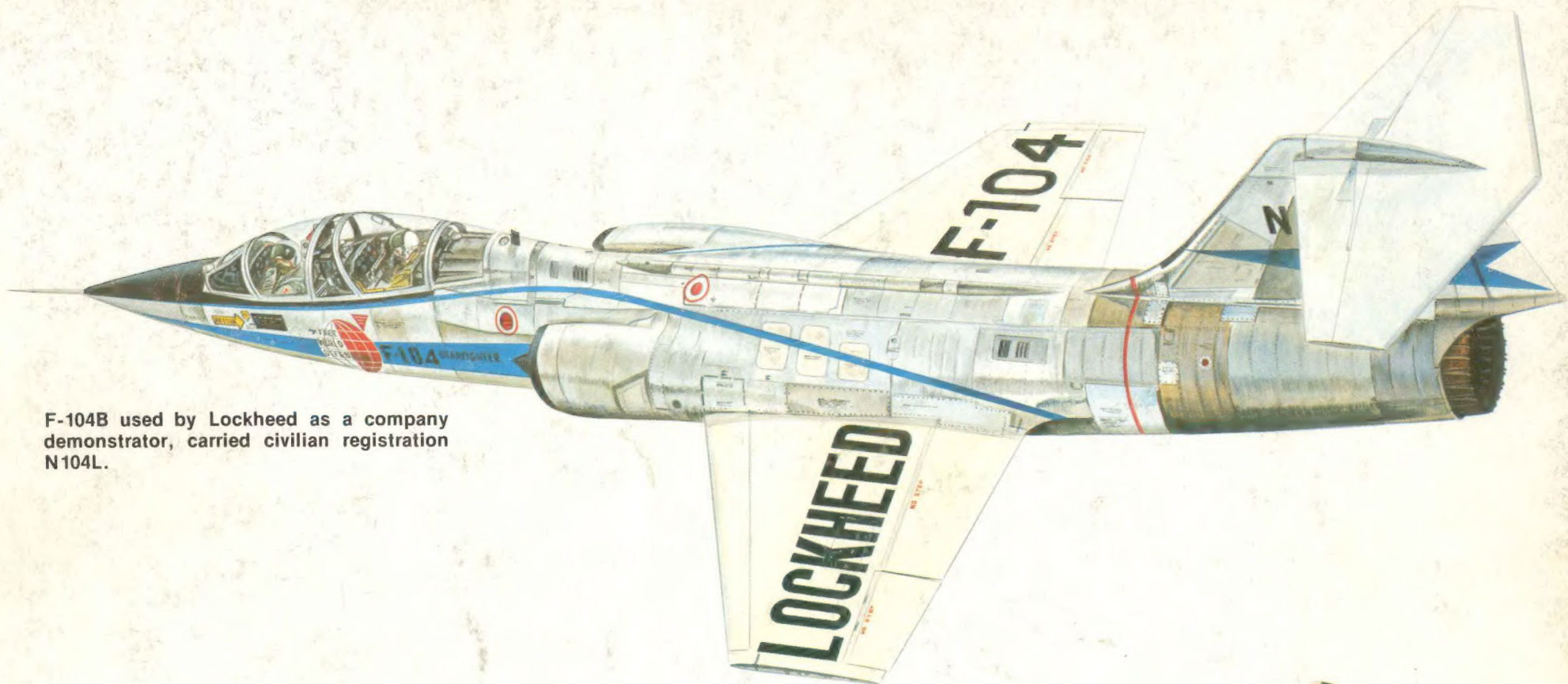
Armor

Weapons

Warships

squadron/signal publications

IN ACTION



F-104B used by Lockheed as a company demonstrator, carried civilian registration N104L.



F-104G of the Nationalist Chinese Air Force. Thought to be one of several 104's to have engaged Migs in air combat.